ENGINEERING NEWS-RECORD

APRIL 29, 1948

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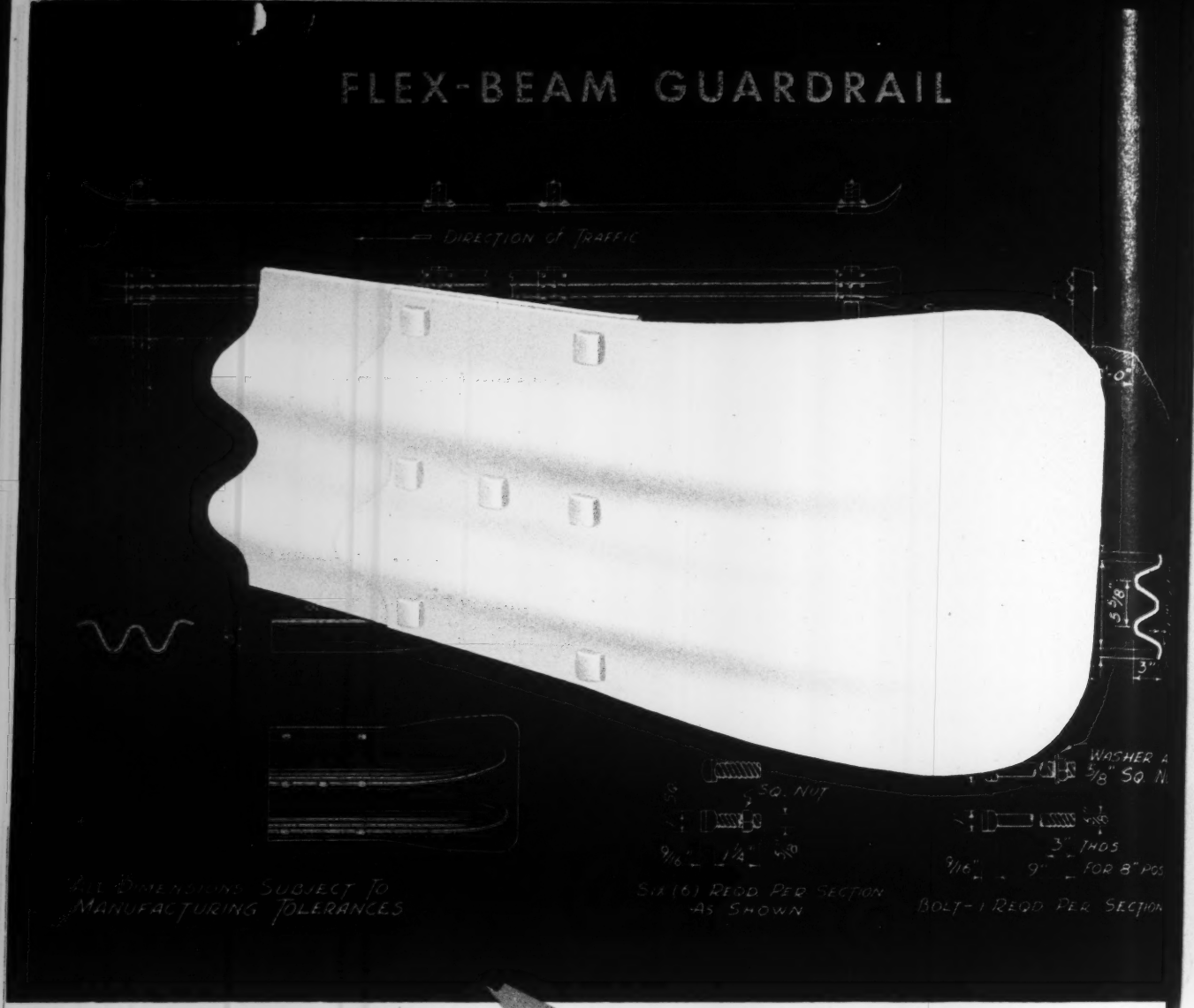

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Volume 140 • Number 18

April 29, 1948

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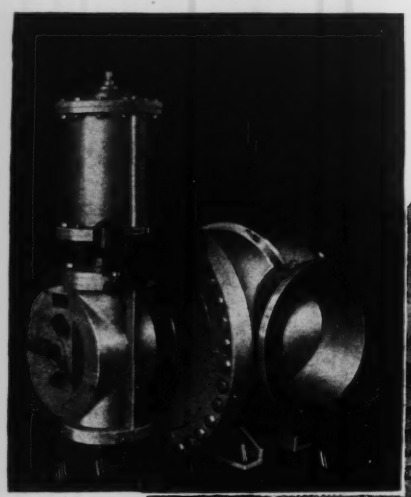

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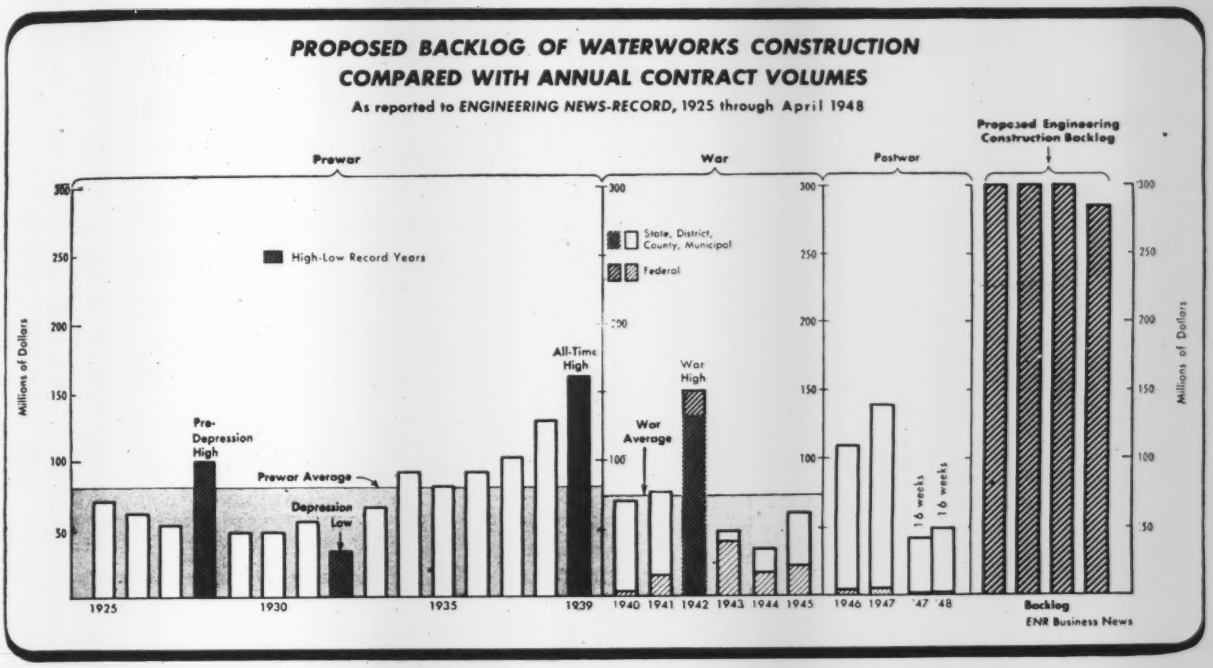

Construction Trends

Waterworks Contracts 19% Ahead of Year Ago

The dollar volume of waterworks construction totals $49,766,000 for the first 16 weeks of 1948, as recorded by *Engineering News-Record*, compared with $41,841,000 in the corresponding period a year ago. Thus, construction contracts awarded so far this year are 19 percent above the 1947 volume. If the weekly rate of contract awards of $3,110,000 is maintained throughout the remainder of 1948, waterworks construction contracts this year may exceed *Engineering News-Record's* estimate for 1948 of $154,000,000, and reach a total of $161,000,000.

Of the total volume of contract awards of $49,766,000 so far this year, $48,807,000, or 98 percent went for state, district, county and municipal work. In the same period a year ago, $41,657,000 went for non-federal jobs, or 99.6 percent of the total.

An analysis of the geographical distribution of waterworks contracts awarded in the U. S. through March shows New England accounting for 24.9 percent of the total, or for $10,-132,000. One large contract awarded in January, totaling $9,530,000 for the tunnel section of the Hultman Aqueduct in Boston, Massachusetts, however, accounted for 94 percent of the total. Other sections recorded the following totals: West of the Mississippi, $7,850,000, or 19.3 percent; South, $7,790,000, or 19.2 percent; Far West, $6,641,000, or 16.3 percent; Middle Atlantic, $4,295,000, or 10.6 percent; and Middle West, $3,-936,000, or 9.7 percent.

For the full year of 1947, the Far West led the several geographical sections, with a total of $36,065,000, or 25.9 percent of the annual volume. Middle Atlantic followed with a total of $32,996,000, or 23.8 percent; West of the Mississippi, with $27,478,000, or 19.7 percent; Middle West, with $22,361,000, or 16.1 percent; South, with $18,122,000, or 13.0 percent; and New England was last with $2,-119,000, or 1.5 percent of the total.

Contracts recorded for New England this year were nearly 8½ times the dollar volume of $1,198,000 recorded in the corresponding period a year ago. The South showed a gain of 293.8 percent, West of the Mississippi, 70.9 percent and Middle Atlantic, 19.8 percent over the corresponding 1947 volumes. The Middle West and Far West registered losses of 1.6 percent and 44.7 percent, respectively.

The backlog of proposed waterworks construction amounted to $1,-183,000,000 at the end of March, based on 1940, 1943, 1944, 1945, 1946, 1947 and 1948 costs and values. This backlog is sufficient to support 7 years of construction activity at the present rate of contract awards.

Additions to the backlog of proposed waterworks construction, however, have been slowing down as compared with a year ago. In the first quarter of 1948, the backlog showed an increase of $28,644,000, considerably less than the $44,742,000 increase in the backlog during the corresponding period of 1947. The dollar value of contracts which advanced to active status from the backlog, amounting to $29,362,000, in the first quarter of 1948 was over 4½ times greater than the $6,403,000 which came out of the backlog in the same period a year ago.

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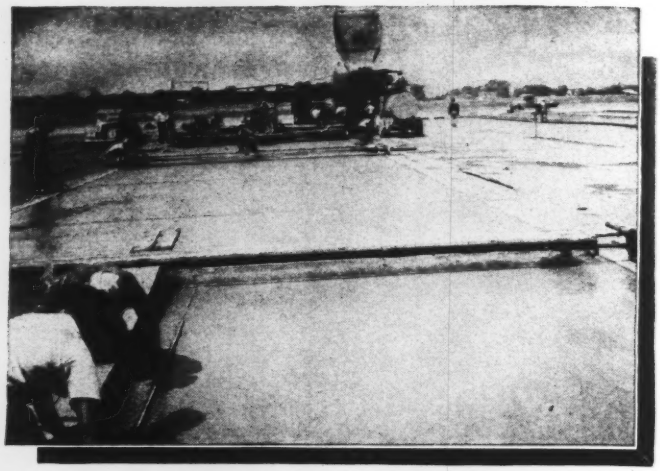

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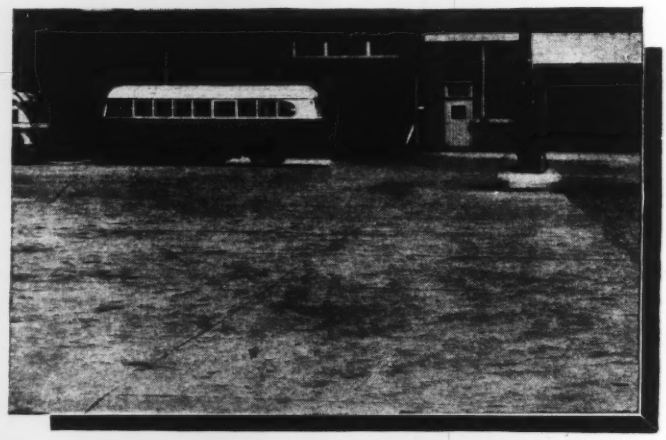

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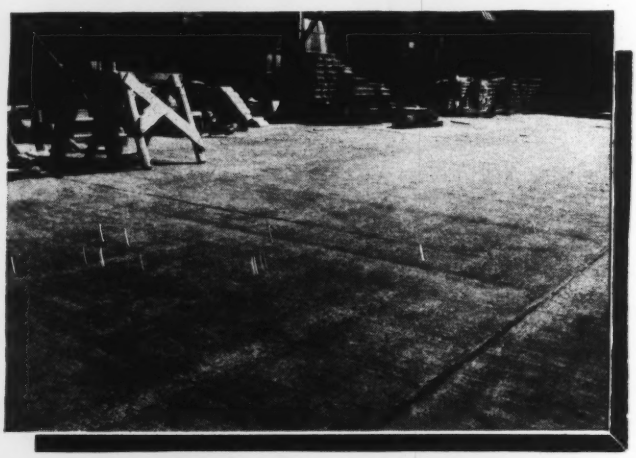

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News of the Week

ENGINEERING NEWS-RECORD • APRIL 29, 1948 • VOLUME 140 • NUMBER 18

Liberia development work includes major construction

U. S. company reveals 80-yr. agreement with republic to exploit economic resources and develop public works —Work supplements earlier lend-lease aid

Staff engineers of The Liberia Company—a privately financed U. S. organization—are now actively at work in the West African republic on a broad program of natural-resources development, installation of public-works and sanitation improvements. Edward R. Stettinius, Jr., chairman of the board of the Liberia Company, disclosed the extent of the work in an interview last week following his return from a month of negotiations with Liberian government officials.

The company has an 80-year agreement with the republic to exploit economic resources and develop social, health and welfare activities. The Liberian government holds a 25 percent interest in the enterprise, with another 10 percent earmarked for a foundation to foster educational, sanitation and general welfare projects.

(This private-enterprize operation follows earlier U. S. government interest in Liberia, which resulted in a $17,000,000 lend-lease obligation for port improvements that are now being completed.)

Capital from private sources

Capital to initiate activities has been supplied by Mr. Stettinius and several associates, the remainder to come from private investors who wish to participate in specific phases of the program. Among these participants is the Virginia Engineering Co. of Newport News, Va., which is handling some of the engineering and construction work.

Chief Engineer of The Liberia Company, which has offices at 521 Fifth Ave., New York City, is Austin Brockenbrough, Jr., formerly director of the Richmond, Va., department of public utilities.

Filled with enthusiasm, the one-time U. S. Secretary of State said that engineering surveys had revealed that mineral, agricultural, oil and lumber resources in Liberia were far greater in potential than the most optimistic guesses made heretofore. Lack of transportation facilities and technological "know-how" have been the principal hindrances to development.

Mr. Stettinius, who is no stranger to the steel business, reported that proven iron-ore deposits of 30-million tons had been located at a point within 40 miles of the seacoast. Of 68 percent purity—much higher than that in the U. S. Mesabi range—the ore would command a price of $8 to $10 a ton at Baltimore. Manganese also has been found.

"Vast quantities of gold are to be had", said Mr. Stettinius, "and a company is to be formed immediately to proceed with the location of sites for its extraction". An affiliated company will be formed to specialize in the extraction of diamonds.

Negotiations have been completed with the Cities Service Oil Co. for the exploration of Liberian oil potentials. At the same time, four other companies are working on plans to establish lumbering operations based on surveys revealing a potential supply of some 27 billion b.ft. of both hard and soft woods.

Transport plans speeded

Construction of highways is on the imperative list of immediate activities, because the country is virtually inaccessible to any kind of transport. Recommendations for the program have been submitted by George A. Green, company consultant on transportation. However, until the roads are built, air-transport will be called upon to serve developments in the interior, particularly in connection with the processing

(*Continued on page* 71)

Plan new power generating capacity

Plans for six major developments to add to power generating capacity in the United States and Canada were disclosed last week. Three of the proposed works are to be steam plants, and the rest will be hydro stations.

The steam developments included a $21,000,000 plant to be built at Windsor, Ont., by the Hydro-Electric Power Commission of Ontario, to serve as a major power source for the southwestern portion of the province; a $25,000,000 station planned by the Delaware Power and Light Co. to supply the Wilmington, Del., area, and a $29,000,000 program of construction, including a new 15,000 kw. generating plant at Lansing, Iowa by the Interstate Power Co which serves some 254 communities in southern Minnesota and Iowa.

Hydro programs included approval of an appropriation of $9,500,000 for further development of the Seattle City Light Department's Gorge project; Federal Power Commission approval of an order authorizing the Wisconsin-Michigan Power Company of Appleton, Wis., to build a new project at Big Quinnesec Falls on the Menominee River; and an announcement of a hydro development on the Ottawa River near Renfrew, Ont., by the Ontario Hydro.

The dam and power plant for the Ontario Hydro will be built 30 miles northwest of the national capitol and will have an ultimate capacity of 160,000 hp. It will be the second large development on the Ottawa River—work on the Des Joachims development, which will have an ultimate capacity of 480,000 hp., already being under way.

The appropriation by the Seattle Board of Public Works will cover construction of an addition to the city's Gorge powerhouse and installation of an additional 66,700 kva generating unit and other equipment.

The Wisconsin-Michigan Co's work will include a concrete gravity-type dam about 640 ft. long and 72 ft. high, and a powerhouse with initial installation of 22,000 hp.

NEWS IN BRIEF

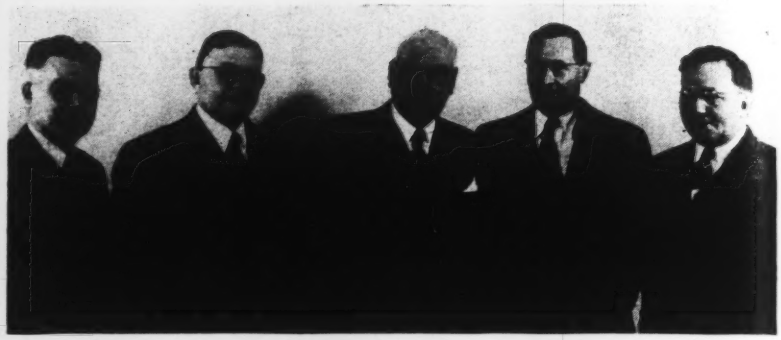
In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Public Construction—*Boston, Mass.*, expects to spend over $7,000,000 this year on public works including hospitals, welfare offices, garages and streets . . . Estimated cost of the proposed Blue Ash airport at *Cincinnati, Ohio*, is $9,808,200 . . . *Tennessee* will proceed with a $17,000,000 state institutional building program . . . J. F. Fitzgerald Const. Co. has been awarded a $3,660,888 contract for the first major permanent building at Logan International Airport, *East Boston, Mass.*—to house 16 airline stations.

Industrial Construction — General Electric Co. has awarded a contract to the H. K. Ferguson Co. for a $2,000,000 glass tubing factory at *Logan, Ohio* . . . A ½-mile long $6,000,000 shopping center is planned for *North Hackensack, N. J.* Owner-builder is the N. T. Hegeman Co., New York City . . . A $1,500,000 fertilizer plant will be built in *Salt Lake City, Utah*, for J. R. Simplot by Door Engineering Co., New York . . . The pulp and paper industry of *Maine* plans to spend $25,000,000 on improvements in the next 5 years according to the Maine Development Commission . . . American Development Co. will build a $20,000,000 rayon plant at *Childersburg, Ala.*

Educational Construction—At least 14 new school buildings will be built over the next 10 years by Southern University, *Scotlandville, La.* . . . Grove City College, *Grove City, Pa.*, has announced a five-year building program including an engineering building and four others to cost about $5,000,000 . . . The Board of Education at *Buffalo, N. Y.*, will soon complete details of a $17,280,000 building and rehabilitation program for the city's schools . . . The Board of School Commissioners at *Indianapolis, Ind.*, is reducing plans for the Emmerich Monval Training High School by eliminating a 400-seat auditorium and cutting down the size of a gymnasium . . . *Halifax, N. S.*, has voted $1,685,900 for school construction.

Streets and Highways—A city-wide traffic survey approved by the *Los Angeles, Calif.*, city council, will be made by D. Grant Mickle, of the Automotive Safety Foundation of Washington; Joe Havener, of the Automobile Club of Southern California; and Stuart Bate, of the Los Angeles Traffic Association . . . British Columbia has voted $5,000,000 for construction of 124 miles of highways, $3,100,000 for paving of 465 miles, $2,500,000 for bridge construction and $1,000,000 for purchase of machinery . . . *Syracuse, N. Y.*, has created a five-member parking authority for purchase and construction of off-street parking facilities . . . Ground was broken April 12 for the $27,000,000 Mystic River Bridge in the Charlestown section of *Boston, Mass.* . . . Rights-of-way for the *Houston-Galveston, Tex.*, expressway are costing about $1,000,000 a mile.



Bridge Experts—Work of preparing plans for a second crossing of San Francisco Bay got under way recently with a meeting between consultants and bridge engineers for the California Department of Public Works. Left to right are: Ralph Tudor, chief engineer, Toll Crosing Division; George L. Freeman, of New York City; C. H. Purcell, California Director of Public Works; Ralph Smillie, New York City, and O. J. Porter, Sacramento.

Housing—A permit has been issued to Florasota Gardens, *Sarasota, Fla.*, for a $1,000,000 apartment and shopping center . . . Some 415 single-family houses will be built on city-owned land in the Oak Hill section of *Newton, Mass.* Houses are to sell for $7,280 . . . Beginning of construction on the second group of six 8-story fully fireproof buildings to provide rental accommodations for an additional 440 families is announced by David Rose, builder of a $10,000,000 apartment house operation in Queens, New York City.

Sewage Disposal—Guy F. Atkinson Co.'s $6,295,518 bid for a filter and drier unit at the Hyperion sewage treatment plant has been accepted by the *Los Angeles, Calif.*, board of public works . . . *Cincinnati, Ohio*, is considering a plan to charge a fee of 60 percent of the water bill to be applied to a fund for revenue bonds for construction of the proposed $25,000,000 metropolitan sewerage system . . . A project under way in *Philadelphia, Pa.*, is the construction of a portion of the lower Delaware low level intercepting sewer, contracts for which total about $2,650,000 . . . *Winchester, Va.*, will spend $958,456 for extension of water and sewer lines and to build a sewage treatment plant.

Water Supply—An increase of about 13½ percent in charges for water sold to *Youngstown* and *Niles, Ohio*, will be considered May 11 in Mahoning County Common Pleas Court, upon the petition by the Mahoning Valley Sanitary District . . . *Huntington, Ind.*, will build a $300,000 14-inch main from the pumping plant to the city, an overhead storage tank of 500,000-gal. capacity, and make changes in certain areas.

Road safety responsibility tested in court action

The Pennsylvania State Supreme Court last week was asked to decide whether a paving construction company is responsible for accidents occurring on a road after the highway is taken over by the state highway department.

In an unusual action, Joseph J. Gurzon, Jr., of Plymouth, asked the state court to award him damages arising out of the death of his father, who was killed in an accident on slippery U. S. Route 11 at Plymouth, in July, 1941. The plaintiff charged that the road paving material—of asphalt—caused the road to be slippery in wet weather.

Company lawyers said the firm had complied with all specifications of their contract, that state inspectors had checked the work at all times, and that the state had approved the work and officially taken over the highway section.

Previously, the Luzerne County Common Pleas Court had ruled that the paving contractor was not responsible.

Magazine articles seen propaganda for federal pollution-control bill

President Veatch of AWWA tells California section his suspicions concerning popular-press stories on hazards of water-pollution—Water rationing methods outlined

Propaganda for the establishment of a federal pollution-control agency is evidenced in recent articles dealing with water supply hazards that have appeared in magazines with a wide circulation among the general public, according to N. T. Veatch, president of the American Water Works Association.

Mr Veatch made this charge before the California section of the association, which met in San Jose on April 16-17. He was the featured speaker on a program that was devoted in large measure to a review of water-rationing measures on the West Coast where shortages have arisen due to drouth.

This is not the first occasion that Mr. Veatch has denounced what he considers to be "misrepresentation of fact" in articles that have appeared in the *Woman's Home Companion* and *Coronet*. Last September (*ENR* Sept 11, 1947, vol. p. 361) he stated his conviction that as a result of such articles public confidence in domestic water supplies has been seriously undermined.

At the San Jose meeting Mr. Veatch quoted passages from articles which, he said, were specifically aimed to create favorable public sentiment for the creation of a federal pollution-control agency with widespread authority. The American Water Works Association holds to the view that stream-pollution control can be most effectively administered by state agencies.

It was alleged by Mr. Veatch that "someone" is paying to have these articles published.

Water-rationing measures

O. A. Gierlich, city engineer and water superintendent, Manhattan Beach, Calif., summarized water-rationing measures taken by various West Coast cities to meet current shortages. Large population and industrial growths during a period when new construction was difficult, if not impossible, have taxed many water systems.

Citing his own city, Manhattan Beach, Mr. Gierlich pointed out that the 1940 population was 7,960 and the estimated 1948 population is 16,000. He further pointed out that rationing is not necessary in most cases except during a few hours of the day during an emergency period. Many cities that have procedures set up have not had to use them, however.

The most common rationing method is to restrict hours for use of water on lawns and gardens so the peak load on the system can be reduced. In one case the even-numbered street addresses use water for such purposes on even days of the month and the odd-numbered on odd days. This does not particularly reduce the total demand, said Mr. Gierlich. A more effective restriction practiced in one or two cities under emergency conditions is to limit use of water on lawns and gardens to the nighttime hours between 8 p. m. and 7 a.m.

The two cities hit the hardest by the water shortage, Ventura and Santa Barbara, Calif., have had to forbid under severe penalty any use of city water on lawns and gardens. The ordinance in Santa Barbara prohibits use of city water for any purpose other than health or sanitation except by special permit issued by a five-man board appointed by the mayor. There is no appeal from the decision of the board, Gierlich said. Other speakers included Randal F. Dickey, chairman of the state assembly interim committee on water pollution; Blair I. Burnson, East Bay Municipal Utility District, and Carl F. Mau, California Water Service Co., San Jose.

Clean stream programs pushed in three states

Further action in the drive for cleanup of streams was reported in three areas last week.

At Jersey City, N. J., the Interstate Sanitation Commission issued a mandatory injunction ordering three New Jersey towns to stop draining raw sewage into the Hudson River. The order—first of its kind obtained by the New York-New Jersey-Connecticut group in its ten-year campaign—was directed against Weehawken, West New York and Union City. Up to the present time the commission's activities have been confined to education and negotiations to persuade communities on the Hudson River and Long Island Sound to go along with its objectives for the control of pollution.

Meeting at Hartford, Conn., members of the New England Interstate Water Pollution Commission agreed to set up tentative standards for water quality for various classified uses and to classify all the state streams in the northeast according to these standards. Representing Connecticut, Rhode Island and Massachusetts, the commission was established under an interstate compact. An advisory board to assist the commission in its classification work includes: W. S. Wise, Warren T. Scott, W. J. Shea and Arthur D. Weston.

The Virginia State Water Control Board ordered a pollution survey of the Holston River near Abingdon, after local sportsmen charged pollution by an alkali manufacturing company.

Disclose Liberian construction plans

(*Continued from page* 69)

movement of vegetable oils. For this purpose, Liberian International Airways, formed last year by an independent group, will begin operations on June 1 with three DC 3's.

Local labor, which can be had for about 38 cents a day, is now being employed to build landing strips in the interior areas.

Meantime, a sanitation mission of The Liberia Company is completing plans for the installation of water supply, sewage disposal and hospital facilities in centers of population. These and other public-service improvements are badly needed, said Mr. Stettinius, who pointed out, for example that one of the first projects to be undertaken is the installation of a telephone system in Monrovia, capital city of Liberia.

Among other moves that are expected to expedite development activities, was the announcement that the Liberia government will apply for membership in The International Bank for Reconstruction and Development and The International Monetary Fund.

Big port almost finished

Quite aside from the contemplated work of The Liberia Company, and having no connection with it, is the construction of a $17,000,000 port at Monrovia. This improvement, which was initiated through the U. S. lend-lease program several years ago, is under the technical cognizance of the Bureau of Yards and Docks, Navy Department.

The Raymond Concrete Pile Co. of New York, contractors on the project, report that the port work is virtually complete. It included the construction of two breakwaters, dredging a 32-ft. basin and the installation of a 2,000-ft. wharf.

Another project to be subsidized with U. S. government funds is the construction of roads and a bridge near Monrovia. The work is expected to cost about $3,000,000.

***Second Biggest**—Surrounded by members of Congress, Secretary of Interior J. A. Krug signs the second largest construction contract ever awarded by the Bureau of Reclamation.*

Sign $43 million Hungry Horse contract

Under the eyes of congressmen from reclamation states, Secretary of the Interior J. A. Krug last week approved the award of a $43,431,000 contract for the construction of Hungry Horse Dam on the Flathead River near the city of Kalispell, Montana.

Second largest in reclamation history—it is exceeded only by the $48,890,000 contract awarded for Hoover Dam in 1931—the new contract was won by a three-contractor group: The General Construction Co. of Seattle, Wash.; the Shea Co., Alhambra, Calif., and Morrison-Knudsen Co. Inc., Boise, Idaho. The multi-purpose concrete structure (*ENR* March 18, vol. p. 403) will be 520 ft. high and 2,100 ft. long, and will require 2,900,000 cu. yd. of concrete. It will be the world's fifth highest and fourth largest concrete dam, exceeded in volume only by Hoover, Coulee and Shasta dams.

A power plant at the toe of the new dam will furnish 300,000 kw. from four 75,000-kva. generators, each driven by a 105,000-hp. turbine. Bids are being taken separately for the generators and turbines.

The work will be the largest single project now under way under bureau supervision.

Commenting on the award, Michael Straus, commissioner of reclamation, pointed out that Hungry Horse will be a key structure in long-range plans for development of the Columbia River basin.

The reservoir will store 3,500,000 acre-ft., and its regulating effect on the river is expected ultimately to result in a total of 1,000,000 kw. more firm power for the Pacific Northwest—through the 300,000 kw. produced at the dam and an added 700,000 kw. at downstream structures. Grand Coulee, Bonneville, Kerr, and Rock Island power plants, and some other either already under construction or scheduled will benefit.

House approves studies of two U. S. parkways

The House last week passed and sent to the Senate two bills authorizing surveys for major parkways.

One measure (H. R. 5609) authorizes the appropriation of up to $200,000 to survey the proposed Mississippi River Parkway, and the second (H. R. 5155) would allow expenditure of $40,000 for a reconnaissance study of a parkway along the route of the government-owned Chesapeake and Ohio Cannal between Great Falls, Md., and Cumberland, Md.—a distance of about 120 miles.

Both surveys would be made jointly by the National Park Service and the Public Roads Administration.

The $200,000 authorization would be used for a survey following in general the route of the Mississippi River. Until such a study has been made, no estimate can be given of the sections of this route which would be suitable for parkway use.

Proposals for a Chesapeake and Ohio Canal Parkway involve a possible future connection to a northward extension of the Blue Ridge Parkway. The bill would authorize expenditure of $40,000 for a survey.

Amend South Carolina registration law

The South Carolina law regulating the practice of engineering and land surveying was amended by the General Assembly at its recent session, to clarify provisions of the existing act.

The principal features of the new registration act include: definitions of the practice of engineering and of land surveying are clarified for easier interpretation; engineering graduates and young engineers who do have four years engineering experience will be permitted to take a preliminary examination without waiting for the requisite number of years experience and will be certified as "Engineers-in-Training".

Under this new measure, any person in a public or private capacity or "offering to practice" engineering or land surveying, must submit evidence that he is qualified so to practice, and it is made unlawful for anyone to practice or offer to practice in the state, if he is not registered under the Act.

Plan N. D. legislation

Plans for legislation to require licensing of out-of-state professional engineers in North Dakota were discussed at a recent spring meeting of the State Society of Professional Engineers at Grand Forks.

Under present laws, out-of-state engineers need no license to work in the state and members of the group said they thought the law should be amended to require such regulation.

Seek water supply bids for Virgin Islands

As a step toward correcting the shortage of water in the Virgin Islands, the Bureau of Community Facilities of the Federal Works Agency will open bids June 15 in Washington, D. C., on several projects for the island of St. Thomas, site of the city of Charlotte Amalie, capital of the group.

Most interesting of the proposed works is an aircraft flight strip that will also serve to divert rain water into underground catchbasins, with a 1,500,000-gal. storage capacity. The flight strip, 4,200 ft. long by 200 ft. wide, is to be located at Bourne Field, just outside the capital, and will cost $280,000. Work will include 94,000 sq. yd. of paving on the runway.

Other construction on St. Thomas calls for the installation of drainage pipe lines to collect potable water, construction of a high level water reservoir and a water treatment plant.

***McNary Dam Work Starts**—Nearly a year after the first contract was let, work is now under way at the site of the huge McNary Dam project near Umatilla, Ore. Steel cofferdams being set in foreground surround right abutment of dam and location of ship locks to handle river traffic. Guy F. Atkinson Co. holds contract for cofferdam work.*

Deny Indian plea to halt McNary dam

A federal district court at Yakima, Wash., last week denied an application for an injunction to halt construction of McNary Dam on the Columbia River, filed by two Indian tribes.

The Yakima and Nez Perce Indians had sought the injunction on the contention that construction of the dam constitutes a definite threat to their fishing rights, guaranteed in a treaty signed in 1855.

A decision handed down by Justice Sam M. Driver said that the damage wrought on the river salmon runs by a cofferdam now under construction "would not be sufficiently serious and not sufficiently irreparable to warrant granting of an injunction." The court pointed out that the matter of what damage would be caused by the construction of the dam itself was not before the court for settlement.

During the trial (*ENR* Feb. 5, vol. p. 166), J. T. Barnaby, chief of the North Pacific fisheries investigation for the Fish & Wildlife Service, testified that damage to salmon runs by the cofferdam or the completed project would be "comparatively negligible." However, Donald McKernan, director of research for the Oregon Fish Commission, testified that the cofferdam would have a damaging effect especially at the water levels where the principal salmon runs usually occur.

Shortly after the court's decision was announced, Col. O. E. Walsh, U. S. district engineer at Portland, said bids would be called early in May for the first major construction on the dam. This work will include abutment, fishways and other matters. The finished structure—expected to cost $180,000,000—will be 7,400 ft long and 160 ft. high, and its waters will supply an initial power installation of 828,000 kw. The Guy F. Atkinson Co., which holds the contract for cofferdams, also holds a contract for the navigation lock.

Ohio bridge explosion brings damage suits

Three persons who were injured in an explosion under a Columbus, Ohio, bridge last August (*ENR* Sept. 4, 1947, vol. p. 301), have filed suits seeking a total of $200,000 damages from the Ohio Fuel Gas Co., Cleveland. Counsel for the trio said the explosion followed almost immediately after the Broad St. Bridge was struck by a bolt of lightning. The three victims were tossed up 50 to 75 ft., and then fell into the Scioto River.

Charging negligence, the attorney said the gas company permitted conditions which caused an accumulation of gas in concrete air chambers under a section of the bridge. The lightning, he said, apparently struck a metal pole and caused the gas to explode.

Circus sued for damages in bleacher collapse

Sixty-four persons were injured recently when a circus "bleachers" section collapsed at Redwood City, Calif. One damage suit asking $75,000 for a broken back and other injuries has already been filed by a woman victim.

Eight rows of seats, designed for 1,000 customers, folded and settled to the ground when A-frame supports with no lateral bracing sank in adobe soil made soft by recent rains.

The circus management had failed to heed a warning by a Redwood City fire inspector that the seats were unsafe and that the performance should be called off. The following day the circus opened on schedule in nearby San Mateo, after city inspectors there were satisfied that 2 x 12-in. blocks placed under the A-frames would prevent recurrence of the accident.

Minimum building wage set by Indiana county

A minimum wage scale that may be taken as a base guide for similar work in the smaller Midwest cities, was adopted recently by the Whitley County Hospital Board at Columbia City, Ind., for construction work on its projected new hospital building.

Architect Charles H. Houck has filed the scale in Indianapolis and has requested federal approval. The scale was adopted as representative of current construction wage scales in Whitley County.

Hourly rates were set for as follows: Iron work, structural and ornamental, $1.75; iron work, rod men, $1.70; lathers, $1.50; millwrights, $1.50; power equipment operators, $1; air-compressor operators, $1; oilers, $1; pile drivers, $1.80; pointers, $1.50; glaziers, $1.30; plasterers, 1.75; asbestos workers, $1.75; plumbers and steamfitters and gas fitters, $1.75; bricklayers, $1.80; boilermakers, $1.80; boilermakers' helpers, (semi-skilled), 90c; carpenters, $1.50; cement finishers, $1.50; electrical constructors, $1.75; elevator constructors (semi-skilled), $1.50; elevator constructors' helpers (semi-skilled), 90c; hod carriers, brick and mortar (semi-skilled), $1; terrazzo workers' helpers (semi-skilled), $1.25; roofers, $1.50; terrazzo workers, $1.50; tile layers, $1.75; truck drivers (unskilled), $1; painters, spray (four-hour shifts), $2; common labor, 90c.

The divisions for the work and occupations were supplied by the Indiana State Labor Department.

Blame sulphur discharge for Los Angeles "smog"

Studies concluded last month by the Stanford University Research Institute and H. F. Johnstone, head of the University of Illinois chemical engineering department, singled out sulphur as the worst offender in the smog problem in Los Angeles, Calif.

Findings of the two studies substantiated statements of Louis C. McCabe, director of the Air Pollution Control District, that Los Angeles oil-burning industries and oil refineries were responsible for the discharge of a major portion of sulphur compounds into the air. Diesel fumes and ordinary automobile exhaust gases have been found to contain sulphur, but would not account for the large volume of the sulphur irritants.

Chemical analysis of Los Angeles atmosphere, together with an experimental "smog chamber", constructed of metal with glass observation windows, were used by the Stanford group. The group, headed by Paul L. Magill, chairman of chemistry and engineering in charge of the smog report, named elemental sulphur as the chief eye irritant. Tests showed that sulphur brings tears in concentration as low as two to five parts in ten million. Concentrations as high as eight parts in ten million were found in the air of downtown Los Angeles.

Tests made with formaldehyde, sulphur dioxide, sulphur trioxide, aldehydes, acrolein and other chemicals ruled these out as eye irritants.

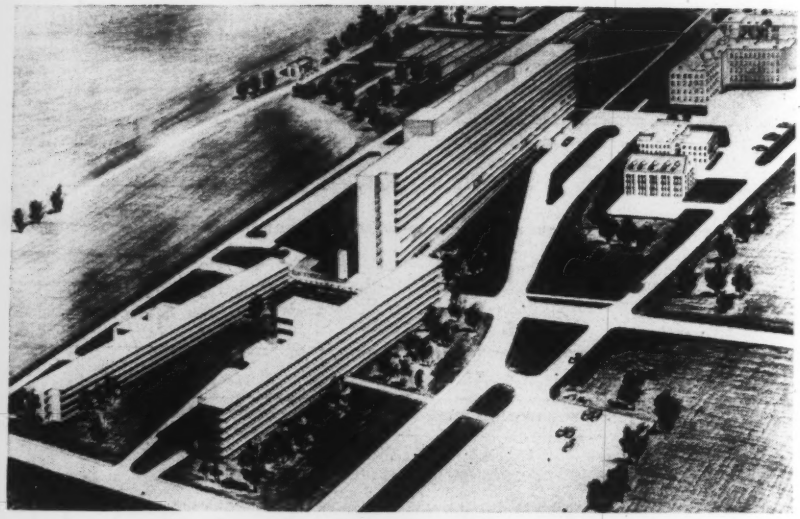
Reorganization planned for B. C. public works

A shortage of professional engineers and a wholesale reorganization faces the British Columbia Public Works Department.

A large-scale highway program—approximating $18,600,000 this year—accounts for much of the shortage of professional men; and retirements postponed during the war years will force the reorganization.

This was the picture presented to the annual conference of the British Columbia district engineers at Harrison Hot Springs in March.

Eight senior government engineers and works officials will retire in June, and three others before the end of 1948. Heading the list of retirees is A. L. Carruthers, deputy minister, whose place will be taken by Norman McPherson, currently deputy, who recently arrived to take the post.



***Teaching Hospital**—Basic construction contracts totalling $7,500,000 have been awarded for an 11-story, 600-bed teaching hospital, and a 3-story dental school at Ohio State University. Joint venturers in the general construction contract are: Grove, Shepherd, Wilson and Kruge; Johnson, Drake and Piper, and Psaty and Fuhrman, all of New York City. Other contracts awarded include heating, ventilating and air conditioning; electrical work, and electric elevators and dumbwaiters.*

N. Y. road work may cost $100 million yearly

The highway program that is necessary and wanted in New York State will cost $100,000,000 every year for 15 years, Superintendent Charles H. Sells of the State Department of Public Works asserted recently in Buffalo.

Addressing the Niagara Frontier Planning Association, Mr. Sells said that if work started immediately on the state highway construction program, every available dollar of the state surplus allocated for highway building would be spent in less than two years. He said that in 1930 the state provided $60,000,000 in the budget, but since then there has been no sizable appropriation for state highway work.

Stressing the shortage of engineers, Mr. Sells asserted the state is holding back on some projects because private enterprise has a prior claim on the construction industry.

Many flood control projects in L. A. area

The Army Corps of Engineers has announced that a comprehensive flood control program in the Los Angeles, Calif., area is nearing completion.

Planned improvements when complete will cost a total of $354,677,197. In all there are 76 flood control projects and eight river and harbor.

Massachusetts begins major road program

Highway construction contracts totalling $35,957,000 and representing the greatest road program ever undertaken by the State Department of Public Works have been awarded or will be awarded before June 30, Massachusetts officials said last week.

California ASCE meeting hears storms end drouth

Intermittent storms that started on March 12 have alleviated the California drouth situation which at one time appeared to be the worst in history, Edword Hyatt, California state engineer, said last week.

Addressing a convention of the four California sections of the American Society of Civil Engineers at Fresno, Mr. Hyatt said that most conservation measures adopted to meet the drouth earlier this year (*ENR* March 18, vol. p. 401) have now been abandoned, since available water is now some 20 percent above last year, although still below normal.

The statewide meeting was the first of its type sponsored by the four California sections, to hear addresses by Mr. Hyatt, R. E. Dougherty—ASCE president, William N. Carey, ASCE vice-president, and others.

Senate approves T-E-W housing bill

Passage of the amended Taft-Ellender-Wagner Bill (S. 866) by the Senate last week moved long-range housing legislation one step nearer a showdown in Congress.

As passed, the bill contains the controversial provision for federal subsidy of public housing, in addition to a number of other features which go beyond the Wolcott Bill (H. R. 5854) approved by the House March 23.

Senate action on the bill improved the prospects of consideration by the House. Chairman Jesse P. Wolcott of the House Banking Committee scheduled a week of hearings starting May 3 and predicted that a housing bill in some form would be approved at this session of Congress.

Some form of housing legislation is urgently needed. The Federal Housing Administration is operating at present on a 30-day, $400,000,000 extension for Title VI authorizations under the National Housing Act. (Title VI mortgage insurance is the instrument for stimulating house construction in the postwar emergency). The 30-day extension expires at the end of this April, and another temporary continuance will be needed.

Essentially, the Senate-approved bill does two things for housing: It offers a transition from the current stimulus of Title VI to the more conservative mortgage insurance principles of Title II, by extending Title VI to March 31, 1949, and allowing additional authorizations of $1,600,000,000. More importantly, the bill marks out a long-range housing program which its advocates hope will encourage construction of 15,000,000 dwelling units in ten years.

Fosters private initiative

The bill aims to achieve 96 percent of this volume entirely through operations of private enterprise. Its public housing provisions set up a system of loans and grants to local communities to encourage slum clearance and the building of rental units for low-income families.

Urban redevelopment (slum clearance) and public housing are covered in separate portions of the bill. To aid communities in eliminating blighted areas, the bill as written authorizes $1,000,000,000 in loans and $500,000,000 in grants. These sums would be subject to appropriation over the five years, 1948-53, one-fifth each year. They would be used by the communities for the assembly, clearance and sale or lease of land for redevelopment.

Grants to a community for this purpose would be limited to two-thirds of the net project costs for acquiring and preparing the land. The Housing and Home Finance Agency would administer the slum-clearance funds.

To promote construction of 500,000 units of urban housing in five years by public agencies, for rental to low-income families, the bill authorizes annual federal contributions to run 40 years for each project. These subsidies would be available only to guarantee amortization of debts incurred by the local housing agencies to build the projects. Federal assistance would be limited to $32,000,000 for the first year, increasing by the same amount annually to a maximum of $160,000,000 in the fifth year. This limit would apply for the remaining years.

Housing research is given central direction and coordination by the bill. It authorizes the HHFA administrator to correlate the whole broad range of research activities, economic as well as technical, enlisting the cooperation of all interested groups for this purpose.

In two places, the bill makes proposals aimed at lowering production costs. One authorizes FHA insurance of construction advances to a builder who has a fabricating or precutting plant on a site when he is erecting at least 25 dwelling units in one-and two-family houses. The second approves insurance of production loans to prefabricators, covering the houses up to the time they are delivered to the site.

Plan repaving roadways on Brooklyn Bridge

With New York City's Brooklyn Bridge approaching its 65th anniversary (May 24), city officials last week were completing plans for reconstruction of the roadways of the structure. At present the 17-ft. roadways on either side of an elevated railroad structure also carried by this bridge are paved with wooden blocks, which, according to Frederick H. Zurmuhlen, Commissioner of Public Works, are so worn and have been patched so many times that they provide practically no traction for automobile tires in wet weather.

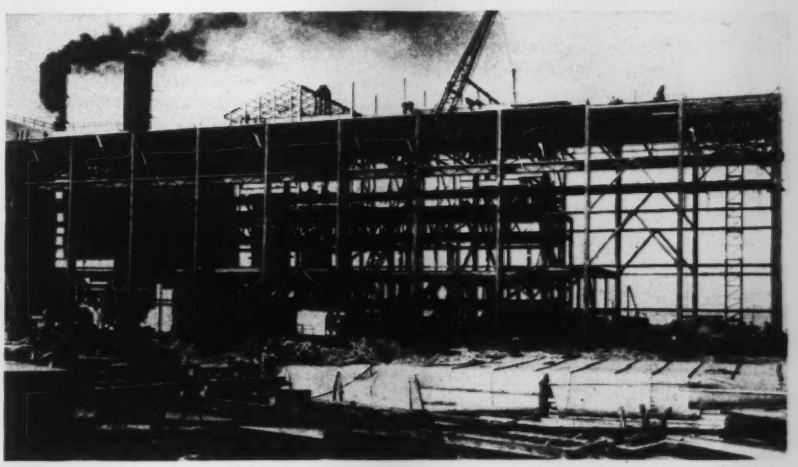
The new plans for the bridge renovation include elimination of the elevated structure, and widening the roadways to provide three 10-ft. traffic lanes in either direction. The estimated cost of the work is $3,000,000.

Coal strike delays New Maine bridge

Start of work on the new $2,500,000 Augusta Bridge across the Kennebec River in Maine will be delayed from a month to six weeks due to the recent strike in the nation's coal fields.

Max L. Wilder, bridge engineer for the Maine Highway Commission, said that the organization had postponed the date for receiving bids for the abutments and piers from April 14 to a date to be determined later.

The effect of the coal strike on steel plants was blamed for the delay.



Power Booster—Electrical energy for power-rationed central California will come next fall from this addition to a Pacific Gas & Electric Co. steam plant in San Francisco. Construction of the new unit, which will add 298,000 hp. to the 62,000 hp. of energy now being generated, is on a 24-hour per day basis. The building frame required 1,230 tons of structural steel, while an additional 1,387 tons were used for boiler supports seen within the framework, all from Bethlehem Pacific Coast Steel Co.

Cement pricing unlawful Supreme Court rules

The multiple-basing-point pricing system used by the cement industry was declared unlawful by the U. S. Supreme Court in a 6 to 1 decision on April 26. Reversing an earlier decision by the 7th Circuit Court of Appeals in Chicago (*ENR* Sept. 26, 1946, vol. p. 410) the Supreme Court concluded that the Federal Trade Commission had been "justified in issuing a cease-and-desist order against a continuation of the unlawful discriminatory pricing system". The dissenting opinion by Justice Burton held that there was not sufficient evidence to prove existence of a combination of cement producers to restrain competition in cement prices.

Essentially the system involves taking the mill price of the plant nearest the point and adding thereto handling charges and freight rates of other mills in the trading area. Uniform cement prices usually result. The FTC has claimed that this price is a result of collusion and agreement, while the cement manufacturers deny this, and point out that uniform prices are inevitable when there is competition in the sale of any standardized product.

Numerous other basing-point price cases are the subject of current FTC hearings, notably that of the steel industry, so that other cease-and-desist orders are expected as a result of the Supreme Court ruling.

Arizona to oppose federal water control

The state of Arizona, where more than 73 percent of the area consists of lands owned or controlled by the government—plans have been made to fight a federal ruling vesting in the government control of nearly all surface water in the state.

The ruling, made in an obscure land case in 1947, could affect hydroelectric power generation within the state, Arizona officials claim, for it stipulates that the government owns all water originating on federal lands. Conceivably, Arizona officials say, the government could stop water from flowing off federal lands.

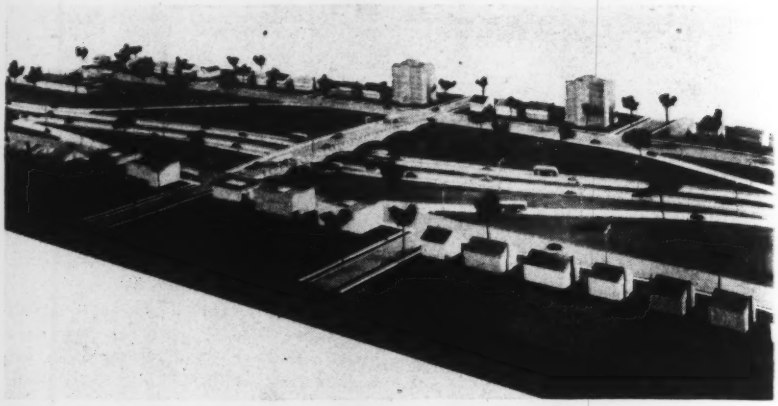
The state is concerned over long-established water rights, especially on the Salt and Verde rivers. It is on these rivers that the vast Salt River Water Users system is established.

The dispute developed out of a ruling made by the solicitor general of the U. S. Department of the Interior, affirming an earlier ruling by the commissioner of the U. S. general land office.

The commissioner had denied an applicant's appeal for restoration of land from Public Water Reserve No. 107 as "being an attempt to secure control of the water and exclude the public from the use of it."

The solicitor's ruling stated "the State of Arizona does not own the right to use of the water either in this reserve or on the public lands of the United States. The territory now comprising the State of Arizona was ceded to the United States at the close of the Mexican War. With this territory there also passed to the United States the water on it, which made part of the land and which was real property in the strictest sense of the word."

Evo De Concini, state attorney general, said Arizona will apply for rehearing of the case and present briefs asking that the ruling be set aside.



Easy to See—Advantages of a proposed $45,000,000 expressway for Milwaukee are easily demonstrated to private citizens through this 1 to 10-in. scale model built by the city's Department of Public Works. The expressway would carry bus traffic in addition to private cars, and the landscaped strip through some of the city's blighted areas would be developed as a playground and recreational space.

Public Health Service seeks assistant engineers

A competitive examination for appointments in the Regular Corps in the U. S. Public Health Service in the grade of junior assistant sanitary engineer (2nd lieutenant) will be held during June, 1948.

Entrance pay for the junior assistant grade, with dependents, is $3,391 a year. An applicant must be a citizen of the United States at least eighteen years of age, and have a degree in one of the several branches of engineering, from a school of recognized standing.

Application forms and additional information may be obtained from the Surgeon General, U. S. Public Health Service, Washington, 25, D. C. Applications are due before June 1, 1948.

North Dakota campus houses lignite laboratory

The campus of the University of North Dakota, at Grand Forks, has been chosen as the site for the $750,000 lignite research laboratory of the U. S. Bureau of Mines.

Thirteen acres on the eastern part of the campus were donated by the University to the U. S. Government for the project. Studies in the use of lignite will be conducted as a part of current efforts to improve available fuel supplies.

Much new road equipment needed for 1948 work

Because of the accumulated deficit of the last few years, some $650,000,000 worth of road building and maintenance equipment will be needed for the 1948 highway program, Charles M. Upham, engineer-director of the American Road Builders' Association, has told equipment engineers.

The association's first postwar Road Show will be held at Soldier Field, Chicago, July 16-24, to demonstrate advances in efficiency of the new road building equipment.

Mr. Upham estimated that $240,000,000 worth of equipment will be required by state, county, and municipal governments for highway maintenance this year. He added that during the war, machinery was necessarily standardized and few changes were made but since then manufacturers have developed new equipment designed to operate more economically and efficiently.

OBITUARY

Ryland C. Bryant, 68, locating engineer for the Southern Railway System until his retirement Dec. 1, 1947, died April 21 in Washington, D. C. A graduate of Howard College, Birmingham, and Alabama Polytechnic Institute, he also took postgraduate work in civil engineering at Cornell University. Mr. Bryant began his career in the railroad industry 47 years ago as a civil engineer for Southern at Knoxville, Tenn. In 1921 he transferred to Washington where he remained until his retirement.

Kenneth C. Fellowes, civil engineer, died in Niagara Falls, Ont. April 18. He was a graduate of the University of Toronto and for many years was a member of the staff of H. G. Acres & Co., engineering consultants. At the time of his death he was resident engineer for the chemical recovery plant of the Consolidated Paper Corp. at Three Rivers, Que.

K. D. McCrary, 42, assistant highway engineer, New Mexico highway department, Santa Fe division, died on April 10. He had been in the department for 18 years, going there from the Texas highway department.

Walter Hasendahl, 64, consulting engineer, died in Los Angeles, Calif., April 8. Born in Germany, he was a graduate of the Heidelberg School of Engineering and headed an engineering firm in Los Angeles.

Harper Hamilton, 54, South Dakota Public Utilities Commission engineer, died at Pierre, April 11.

Edward M. Richbourg, 65, for 30 years civil engineer for the Los Angeles, Calif., County roads department, died April 8 in Los Angeles.

Col. Henry R. Brewster, 72, a civil engineer graduate of Cornell University, 1898, died in Syracuse, N. Y., April 19. He was an Army engineer in the first world war and served as assistant director of engineering in the Syracuse area for the WPA.

Thomas J. O'Reilly, 72, retired civil engineer, died April 20 in Niagara Falls, N. Y. He was with the city engineering department prior to his retirement.

Arch F. Rakatsky, 49, East Hampton, Conn., senior engineer in the bridge design division of the Connecticut State Highway Departmment, died April 20. He was graduated from Sheffield Scientific School, Yale University, and was with the highway department for 22 years.

J. N. Bridgman, former member of the civil engineering department of the University of Nebraska, died recently in Sierra Madre, Calif.

James J. Reagan, 88, of Weaversville, N. C., civil engineer and mathematician, was killed in an automobile accident at Swannanoa, N. C., April 20.

Ralph N. Harwich, 59, Buffalo, N. Y., engineer, died April 22. He had been president of the Hardwick Engineers, Inc., consulting engineers.

Sylvius Lanson, 63, civil engineer who was born in Malta and went to Canada in 1911 to work on the Welland ship canal, died in Toronto, Ont., April 18. He had been with the Canadian National Railways and the Ontario highway department.

Expands light plant

Work started at Columbus, Ohio, on a $1,400,000 program to expand and improve the city's municipal light plant. The program will include construction of an extension east of the structure on Dublin Ave. to house a boiler and stoker.

Another extension, to house a turbine and generator, will be finished in 1949. The improvements will provide an additional 3,000 kw. capacity to increase the over-all capacity to 16,500 kw.

MAJOR MEETINGS

National Public Housing Conference, Inc., Hotel New Yorker, New York, N. Y., May 3-5.

American Water Works Association, 1948 conference, Atlantic City, N. J., May 3-7.

Second Highway Transportation Congress, Mayflower Hotel, Washington, D. C., May 6-7.

Canadian Association of Equipment Distributors, General Brock Hotel, Niagara Falls, Ont., May 10-12.

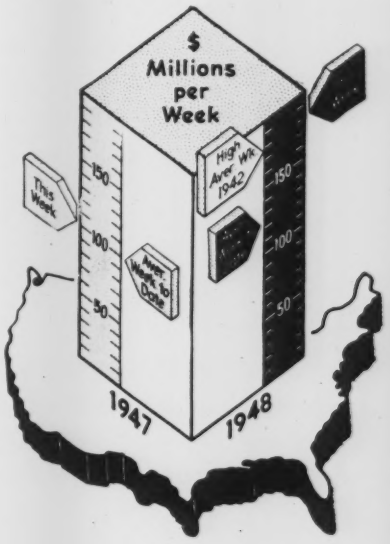
Society for Experimental Stress Analysis, The Roosevelt Hotel, Pittsburgh, Pa., May 27-29.

National Conference of Community Planning, annual meeting, Banff Springs Hotel, Banff, Alta., June 2-5.

American Society for Engineering Education, 56th annual meeting, University of Texas, Austin, Tex., June 14-18.

American Society for Testing Materials, annual meeting, Hotel Book-Cadillac, Detroit, Mich., June 21-25.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only (Thousands of Dollars)

	Week of Apr. 29 1948	Cumulative 1948 (18 wks.)	Cumulative 1947 (18 wks.)
Federal	$47,851	$404,394	$168,123
State & Mun.	66,553	750,937	513,782
Total Public.	$114,404	$1,155,331	$681,905
Total Private	68,849	1,046,522	1,062,922
U. S. Total.	$183,253	$2,201,853	$1,744,827

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1948 (18 wks.)	Cumulative 1947 (18 wks.)
Waterworks ...	$2,960	$56,468	$44,459
Sewerage	9,699	74,915	31,363
Bridges	5,141	95,970	53,676
Highways	25,779	285,060	225,176
Earthwork, Waterways	45,730	211,180	92,320
Buildings, Public	17,034	354,942	167,927
Industrial ...	11,285	326,368	277,063
Commercial .	52,276	635,187	640,401
Unclassified ...	13,349	161,763	212,442

NOTE: Minimum size projects included are: Waterworks and waterway projects, $28,000; other public works, $50,000; industrial buildings, $68,000; other buildings, $250,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1948 (18 wks.)	Cumulative 1947 (18 wks.)
NON-FEDERAL	$1,224,426	$573,374
Corporate Securities	703,546	203,454
State and Municipal	520,880	369,920
Total Capital	$41,224,426	$573,374

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Apr.'48	438.50	210.79
Building Cost	Apr.'48	329.42	178.07
Volume	Mar.'48	250	110

EDITORIALS

VOLUME 140 NUMBER 18

April 29, 1948

State-Wide Conferences

THERE IS MUCH that can be said in favor of state-wide meetings of engineers and construction men without detracting from the advantages of national conferences. And of particular significance is the fact that the state-wide gatherings make it possible for a large number of men below the level of department heads, who seldom can get to national meetings, to sit down with their fellows to discuss mutual problems. A recent example is the three-day conference in Columbus, Ohio, under joint sponsorship of Ohio State University and the Ohio State Highway Department, which attracted 670 highway maintenance and construction men. National highway problems were not overlooked, but the focus was on the local level. Similar meetings on flood control have been equally useful, as have those on water supply, sanitation, building codes and regional planning. When carefully planned, such conferences can exert strong influence in raising the standards of engineering and construction accomplishment in any state.

Long-Range Road Plans

PERSPECTIVE is needed if our road planning is to be done adequately. That is what G. Donald Kennedy clearly demonstrates in an article published elsewhere in this issue. Too much road planning in the past was on a hand-to-mouth basis, and almost none was done with proper recognition of the cumulative effect of obsolesence. As a result, many states are still paying for roads that have been worn out and replaced, and few if any are building or rebuilding roads at a rate adequate to keep pace with growing needs. This is due in large measure to lack of complete data on road needs and road life, data that now are available in the planning studies conducted by the states in cooperation with the Public Roads Administration during the past few years. Enough states now have compiled and analysed these figures to make it possible to predict what the annual needs will be for the next 20 years. The amount is staggering; slightly over three billion dollars of new construction and nearly one billion for maintenance, bring the total annual highway-money need to over four billion dollars when debt service is included. One fact stands out sharply from Mr. Kennedy's statement concerning future needs. There can be no turning off and turning on of road expenditures during the next decade as a means of stabilizing employment. The accumulated deficit is so great that adjustments of that kind should not be made until the average annual rate of expenditure is much higher than it is today. In other words, just because employment is high today there should be no curtailment of highway expenditures to build up a reserve to be spent should a depression come. The amounts involved are considerably more than have ever been spent in any past years including those when road work was being used to relieve unemployment. The job ahead is one that must be faced with vision and with vigor.

Pumped Storage of Power

THIS COUNTRY has lagged far behind European countries in using water pumped into high-level reservoirs as a means for meeting peak loads in power systems. There are only a few such plants here as against about 40 in Europe (p. 85). This probably is due to different physical and economic conditions, but whatever the cause, it now appears obvious that more attention should be given to the possibilities of this source of power as a means for meeting peak demands on the expanding power system of this country. Pumped storage creates no new power. Actually it wastes power, but its value lies in the fact that low-value off-peak power can be used to pump water into a high-level storage reservoir from whence it is drawn at times of peak load to generate power that can be sold at a much higher rate. Most European plants are used to meet daily peaks, but a few are for seasonal use. In this country, it may be found that seasonal storage offers greater possibilities for system economies.

New Frontiers for Development

A NEW PATTERN for private-enterprise participation in foreign development was unfolded last week. As described on p. 69 of this issue, a recently organized American firm, The Liberia Company, has negotiated an 80-year agreement with the government of Liberia to promote the economic, financial, educational and social development of the West African republic.

There is no precedent for such an arrangement, visioning as it does a partnership between a foreign government and a group of private individuals, which is aimed at creating higher living standards and making it profitable for everyone concerned. Although a similar philosophy pervades the efforts of Nelson Rockefeller in the conduct of his International Basic Economy Corporation in South America, this latter operation is confined to a limited number of projects in contrast to the overall program of country-wide development to be undertaken in Liberia.

Under the leadership of E. R. Stettinius, Jr., former U. S. Secretary of State, The Liberia Company proposes to bring to an undeveloped country those management, technical and other skills that will promote most effective use of both human and material resources. In so doing, the company will utilize affiliates to carry out specific projects, and thus furnish the opportunity for other U. S. firms to participate in the venture. One of the partners is The Virginia Engineering Co., to which has been assigned engineering and construction tasks; another is The Cities Service Oil Co., which will embark on oil exploration. Companies engaged in many types of development and consumer-goods operation are expected to participate, and there will be opportunities for specialists in all forms of endeavor, notably in the fields of public health, education and other forms of social welfare. A guarantee that these human necessities will not be sidetracked while resources are being exploited is contained in the agreement setting aside 10 percent of the profits for this purpose.

Essentially, this agreement of the Liberian Republic with American businessmen is designed to create a stable political and economic climate that will prove mutually profitable for all parties. It recognizes that Liberia's potentially great wealth in agricultural, mineral and timber resources is virtually useless now. And it acknowledges that America "know-how" is likewise a useless commodity to Liberia until it can be effectively harnessed to meet the country's needs. The plans of The Liberia Company, coupled with the desires of an improvished nation, promise new horizons for the people of Liberia and new frontiers for private enterprise. And in so doing they offer another opportunity for American engineers and construction men to enlarge their field of operations.

Advances in Water Practice

ADVANCES in water-supply practice are seldom so dramatic by themselves as to capture exclusive attention. Any appraisal of progress, therefore, can best be served by an assembly of current developments which, taken together, indicate the range and scope of improvement measures. Such is the purpose of the special section beginning on p. 93 of this issue.

Of major significance, perhaps, in the field of water-treatment research, is that relating to the use of the electron microscope. Capable of magnification to 200,000 diameters, this new tool is being used by the authorities at the Chicago South District filtration plant on bacterial and coagulation studies. One aim of the work is to develop procedures for immediate identification of coliform bacteria. While there is some doubt that effective control of water quality by microscopic examination can be accomplished, it is anticipated that individual colonies of different types of organisms can be concentrated close enough for survey under the one millimeter field of view by centrifugation.

For hydraulic engineers, there is more than academic interest in the description of a simplified Venturi tube that is more efficient and less costly than conventional meters. Designers and operators will likewise take note of the unusual rapid-sand filter installation at Newton Falls, N. Y., which operates at rates varying from 500 to 3,200 gpm., and removes 99 percent of suspended solids with no pretreatment other than chlorination. Cost-conscious sanitary engineers will learn how a Parshall flume was modified to combine inflow measurement and chemical mixing in a single structure. Use of this novel structure not only reduced construction and operating costs by eliminating mechanical mixing equipment, but also conserved needed hydraulic head.

Even when looked upon individually, these developments are not without distinction. But taken together as representative of advances in current practice, they represent strong new links in an unbroken chain of progress.

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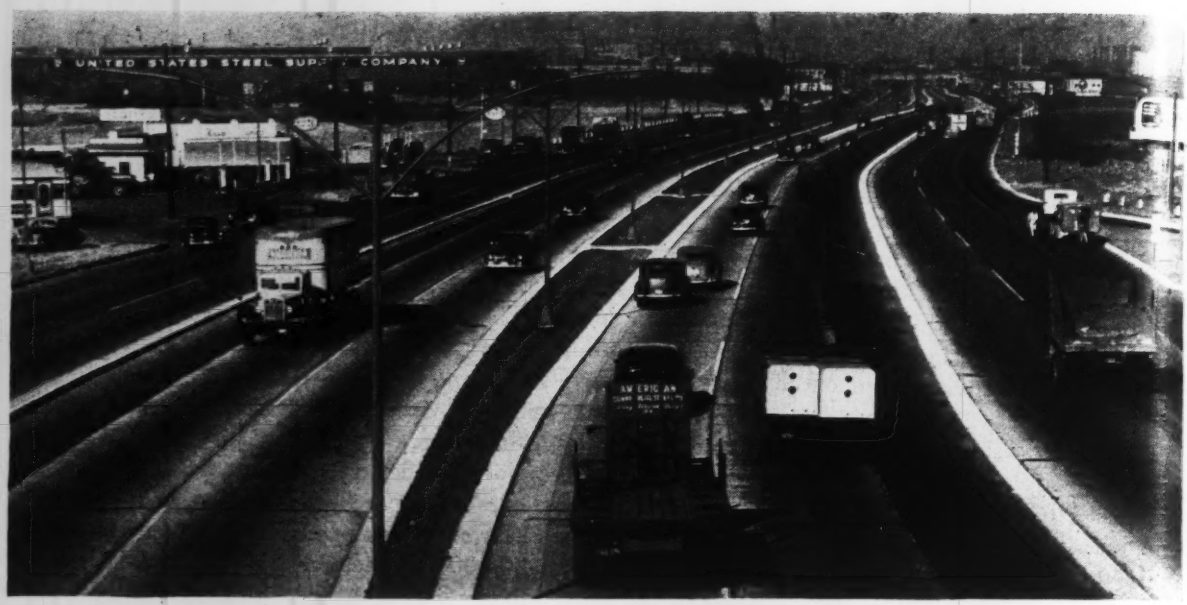


Fig. 1. Safety has to be built into highways, and that requires careful planning if costs are to be kept down. On New Jersey's rebuilt Route 25, each dual lane is provided with a paved shoulder where vehicles can stop clear of traffic.

Annual Highway Need of $4 Billion Places Emphasis on Planning

G. Donald Kennedy
Vice President, Automotive Safety Foundation
Washington, D. C.

***Editor's Note**—The Automotive Safety Foundation was organized in 1937 by leaders in the motor vehicle, parts and tire industries to work for a reduction in the nation's traffic death toll. In 1942, its program was expanded to include the sound development of a safe and efficient highway transportation system, at which time the petroleum, steel and cement industries joined in contributing to the support of the foundation. The following year, G. Donald Kennedy was engaged as vice president to head up this highway development work. Previously he had served as deputy state highway commissioner and as highway commissioner of Michigan for nearly ten years and had taken an active part in work of the American Association of State Highway Officials and the Highway Research Board. He was vice chairman of the National Interregional Highway Committee whose special report was submitted to Congress in 1944.*

ACCUMULATED road and street deficiencies, higher construction costs and increased demands of road users, are factors that point to the need for a total annual expenditure of about four billion dollars on the highways of the United States. Travel already has exceeded pre-war records, and forecasts strongly indicate a 50 percent increase by 1960. The urgent need to eliminate waste and establish a planned, engineering approach to the highway problem is plainly evident.

Roadbuilding as we know it today began only 30 years ago. In those three decades America became truly a motorized nation, with every aspect of its development hinged to the motor vehicle and the highway. Despite the fact that the highways were always far short of actual needs, motor vehicle ownership and usage grew and grew.

What the future holds is illustrated by the statewide planning studies made by the state highway departments in cooperation with the Public Roads Administration. This work would indicate that in the near future vehicle miles of travel, vehicle registration, and gasoline consumption all will set new records, as shown by the accompanying chart (Fig. 2). A study of this illustration shows that even the depression of the 30's scarcely halted the upward swing in

the ownership and use of cars. World War II brought a pause, but with the coming of peace, motor vehicle travel resumed its pace, 1947 registering a 10 percent increase over 1941.

Planned improvement required

A good question is—what are the requirements to meet these expansions? One requirement is the provision of an orderly and sustained rate of rebuilding and modernization of our highway system, with the program supported by a sound system of public finance. To accomplish this objective will require research, planning, the best of engineering and public administration. Another demand is that through engineering, education and enforcement, travel shall be made safe. High accident rates and inadequate roads are co-enemies of efficient, economical highway transportation.

A third requirement is, through modern design, to provide adequate capacity in each section of road for the orderly smooth flow of traffic. Special attention must be given to avoiding the frictions that are common to all channel movements and which in this instance spell death and disaster for thousand of Americans each year.

Continuing construction needed

In this planning we must eliminate many misconceptions about highway development and financing of highways. Some years ago, for example, it was believed, and some still may believe, that highways could not and should not be built to withstand the impact of heavily loaded trucks. Now it is commonplace to design structures to provide adequately for highway truck loads that are kept within sound limits of size and weight.

There are those who believe that roads will last indefinitely. Actually, there is a mortality connected with road life that is just as sure and certain as human mortality.

There are others who would turn road programs off and on—reducing them in good times when prices are high and accelerating them during times of depression with work relief; and, of course, in war times, eliminating all road construction. The net result would be to leave no time for a proper program. I hope to demonstrate that we need an orderly, sustained, minimum program at all times, except in war emergencies, to achieve the objective of a sound highway system.

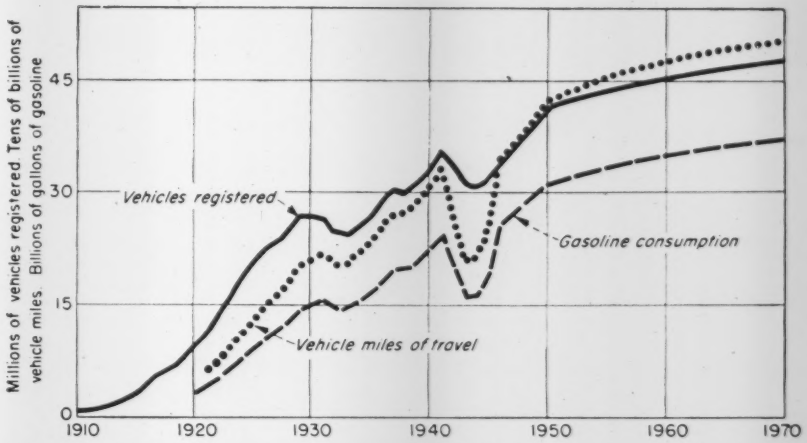


Fig. 2. Total U. S. vehicle registration and vehicle miles of travel are expected to show a 50 percent increase over prewar years by 1960, and gasoline consumption will show a big gain.

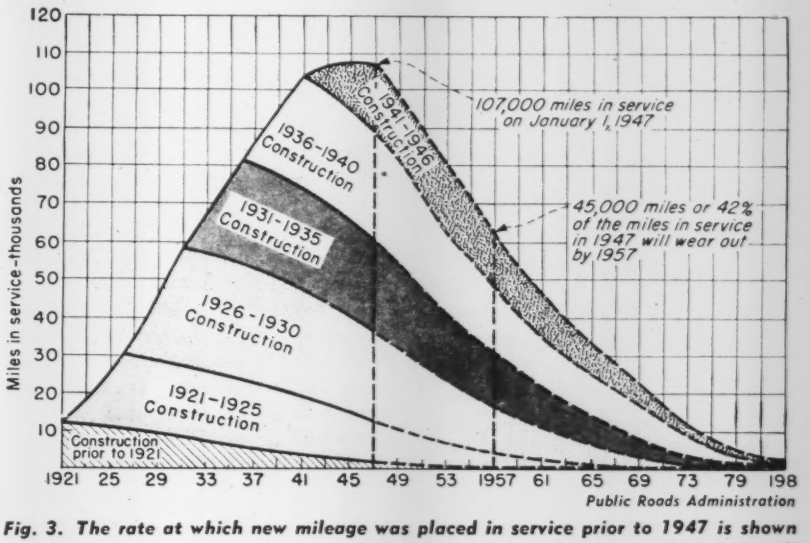


Fig. 3. The rate at which new mileage was placed in service prior to 1947 is shown at the left, and at the right is the estimated rate at which these highways will wear out under traffic.

Today we are carrying on a large postwar federal-aid highway program. We are now in the third year of a program which, with federal-aid, amounts to three billion dollars. By March 1, 1948, approved projects programmed for construction totaled $2,124,537,071, yet awards of contracts lagged behind, totaling only $1,211,186,030. As matters now stand, we not only have to catch up on the current program, but with the enactment of another program by Congress it will be necessary to accelerate the work under way. It is evident that the lag in progress is attributable to conditions over which there is no control, such as shortages of technical men, skilled labor, equipment and materials, and high costs.

Highways wear out because of structural failure due largely to obsolescence and because they were not designed for the carrying capacity needed today, and it is possible to predict from the rate at which mileage was placed in service on the federal-aid system between 1921 and 1947 a rather definite rate at which the country's roads will wear out in the future (Fig. 3). According to the facts obtained from the planning studies, in the next ten years 45,000 miles, or 42 percent, of our high-type highways will wear out. In addition, by 1957 over 102,000 miles

of intermediate and low-type roads will need to be reconstructed. So, much of the future construction job will consist of replacement of those roads wearing out.

Another large job is broadening of the program to embrace those roads and streets that have never had adequate traffic-carrying capacity. These roads are the more heavily traveled sections located on legally classified systems known as the federal-aid primary, federal-aid secondary, and in the city street system those elements commonly known as major streets.

Reduction of construction expenditures during the past few years—and, generally speaking, the trend has been downward since the large programs of the late 20's—has brought about a condition of higher maintenance costs (Fig. 4). This chart illustrates that when construction falls behind over a long period of time the bill must be paid in another way, through higher maintenance costs.

Heavy traffic on limited mileage

The approach to an orderly future construction program is, of course, through sound highway planning. The first step is road classification—according to use and according to jurisdiction. It has been learned from the planning surveys by the state highway departments that 86 percent of all highway travel on rural roads is carried by 700,000 miles of road, comprising only 23 percent of the total rural highway mileage (Fig. 5). Within that 700,000 miles, the first 100,000 miles carry by far the largest share of traffic, or some 40 percent.

The remaining 2,300,000 miles of rural land-service roads of the U. S. carry a relatively insignificant amount of traffic, averaging only about 30 vehicles per mile per day. It is shown that as much as 600,000 miles of public highway could be abandoned in the public interest and that the concentration of funds should be made on the 700,000 miles of general use roads. Within this mileage are to be found the interstate highway system, the principal state highways, the federal-aid secondary system and the urban extensions of the major highways. To meet the vast demands, the public program becomes one of concentration of funds on roads of general motor use. Such concentration comes into sharp conflict with the political aims of many legislative bodies.

Revenues today, in contrast to earlier days, are raised largely from the users of the highways rather than from taxes on property. In many instances, unfortunately, that money is diverted to non-highway use. That inequitable condition has been corrected in many states and is being attacked by local and national organizations and by civic leaders.

An even more serious difficulty, however, is the fact that a large amount of motor vehicle revenue is being dispersed from the roads of general motor use onto roads of relatively little importance. Recapture of those funds to concentrate them on the general use roads of the country is one of the greatest challenges ahead of highway transportation.

The classification of roads with highest traffic volumes is found in the newly created 40,000-mile interstate system of highways (*ENR* Aug. 7, 1947, vol. p. 165). This system comprises slightly more than one percent of the country's road and street mileage and yet when completed it will carry more than twenty percent of all of the highway traffic of the U. S.. It will connect the principal cities of our country; it will serve a tremendous volume of inter-urban traffic; it will carry the routes into and around the hearts of the cities; and it will constitute a nationally interconnected system of highways. Also, it will serve in peace and war.

Much urgent work needed

The improvement of the interstate system, the replacement of one-half the mileage of the federal-aid primary system, which must be done within the next ten years, and the improvement of secondary roads and urban streets are all urgent jobs. How much will all of this cost? We know that costs vary greatly on different roads. In an accompanying table are given for both urban and rural areas estimated costs per mile for constructing federal-aid primary highways and federal-aid secondary roads, and unit costs estimates for major and local streets, and rural service roads. These unit costs led to the preparation of a total national budget for the cost of highway improvement.

The figures available today are estimates of the cost of highway improvements for the entire country. They are based on accumulated data from the highway planning surveys and from the application of the soundest analytical judgment that can be brought to bear on this problem.

These figures show for the first time the cost of an adequate highway and street program in this country. The average annual expenditure requirements listed are not to be con-

TABLE I—AVERAGE ANNUAL HIGHWAY EXPENDITURES REQUIRED FOR AN ADEQUATE HIGHWAY AND STREET PROGRAM.

	Amounts for Land-Service Roads	Amounts for General-Use Roads	Total
Construction	$700,000,000	$2,400,000,000	$3,100,000,000
Maintenance and Administration	500,000,000	400,000,000	900,000,000
Debt Service, Collection Expense and Administration	25,000,000	275,000,000	300,000,000
	$1,225,000,000	$3,075,000,000	$4,300,000,000

TABLE II—RANGE OF AVERAGE FUTURE CONSTRUCTION COSTS PER MILE FOR VARIOUS ROAD AND STREET SYSTEMS.

Road Systems	Rural Sections	Urban Sections
Interstate	$50,000 to $250,000	$500,000 to $2,000,000
Federal Aid—Primary	25,000 to 125,000	250,000 to 1,000,000
Federal Aid—Secondary	5,000 to 25,000	15,000 to 75,000
Streets of Major Importance	.....	250,000 to 2,0000,000
Local City Streets	.....	15,000 to 75,000
Rural Land-Service Roads	up to $5,000	.....

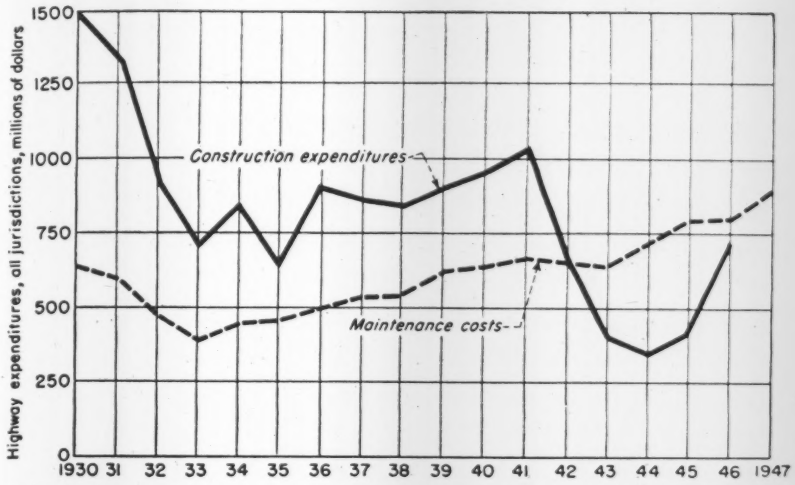


Fig. 4. With the reduction of construction expenditures during the war period, maintenance costs continued the climb of the past several years and totalled over $800,000,000 during 1947.

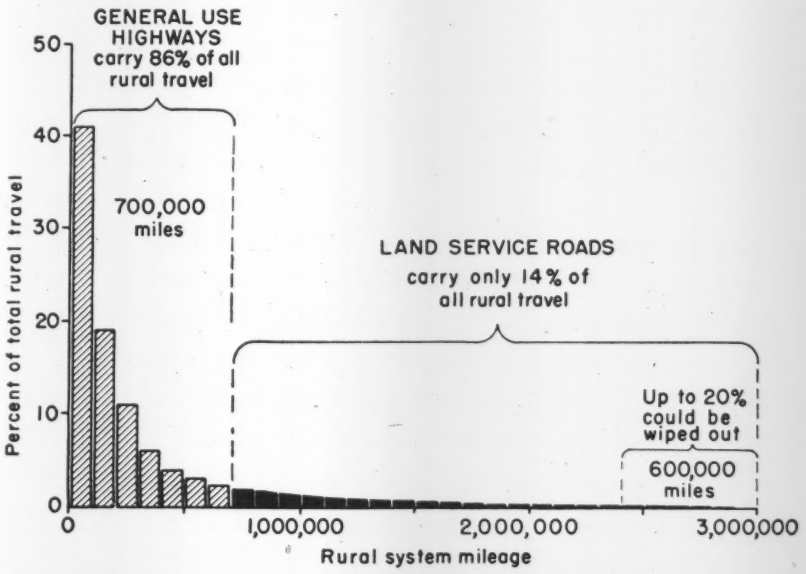


Fig. 5. Studies of the intensity of travel on rural roads have shown that 86 percent of the total travel on these routes is carried by the 700,000-mile rural system comprising only 23 percent of the total rural mileage. In this chart the height of each bar shows the percent of total rural travel carried by each 100,000-mile increment to rural highway mileage.

sidered the requirements for 1948 or any one year. Instead, they are the expanded requirements over a period of ten or twenty years on an annual basis with allowance for a higher price index. These annual needs are given in Table I.

In studying that table it should be noted that a recent study of needs in 42 states by the American Association of State Highway Officials revealed that a total of 22 billion of construction is needed to bring the country's federal-aid highway systems up to the desired standard (*ENR* Feb. 26, 1948, vol. p. 311). With allowance for expanded needs of the future, particularly in urban areas, budget needs for construction on general-use roads, which must receive the highest type of improvement, are $2,400,000,000 annually.

How should this latter job be done? A first consideration is the program of the federal government, its technical participation, the amount of federal-aid funds, and its general importance in the highway program.

Federal-aid binds together the work of the 48 states into one common network of achievement, with the sovereignty of the states preserved. To participate in federal-aid programs, each state is required to: (1) maintain a highway department of high standards; (2) provide funds for highway maintenance; (3) classify its mileage into eligible systems; (4) agree to uniform standards of construction and design; (5) meet inspection requirements mutually agreed to by the state and the federal government; (6) match federal funds under the current acceptable standards; (7) agree not to divert additional highway funds; and (8) eliminate dispersion of highway funds on projects that involve federal-aid.

The history of federal-aid has been one of outstanding achievement. Through the efficient and progressive PRA and the work of its great leader, Thomas H. MacDonald, the federal-aid highway program stands high on the list of the U. S. Government's contributions to the national welfare.

Federal-aid should continue

The federal budget provides a relatively small but important part of the total highway expenditure of the country. During the last several years, federal-aid has averaged about 16 percent of the total highway budget (Fig. 6), and of $2.3 billion spent on highway construction and maintenance in calendar 1947, only 14.7 percent was federal funds, according to PRA figures. That ratio of federal highway aid to the total highway budget has produced highly satisfactory results in the past. If we are to continue to get the utmost values from highway tax dollars in the future, federal-aid therefore should be continued in about the amounts provided in the present act, or $500,000,000 annually.

Such an amount, continuing the sixteen percent ratio, should be viewed in the light of two developments. One is the materially increased cost of construction, which is presently averaging from 80 to 90 percent more than in 1940. Another factor is the provisions of the Federal-Aid Act of 1944, which for the first time brought matching funds to urban projects and which provides

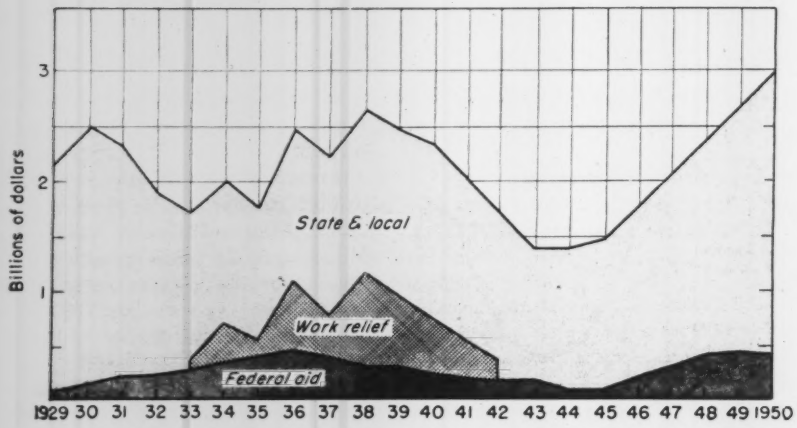


Fig. 6. During the past several years federal-aid for highway construction totalled only about 16 percent of all expenditures on the country's highway system. For example, in the year 1946, of the $2 billion spent, including maintenance work by state and local groups, only 13.8 percent was federal money, and of a total of $2.3 billion in 1947, federal aid accounted for only 14.7 percent.

for specific designations and development of farm-to-market roads.

The American Association of State Highway Officials at its recent convention adopted a resolution calling upon Congress to continue the three-year program when its third year shall expire next June 30, and to follow it with another three-year program of the same magnitude. A bill to do that recently was passed by the House and is pending in the U. S. Senate. Continuation of this federal-aid program is of the utmost importance to achieve a sound national system of roads and streets.

Role of state groups

What is the role of the state government? This is well answered by recent developments in California. The California legislature, faced three years ago with great demands for road improvements and for the creation of entirely new systems of roads, was at a loss as to how to meet the tremendous requirements. A legislative fact-finding committee, headed by State Senator Randolph Collier, made a two-year investigation of road needs. A vital part of the work was a report, "Engineering Facts and the Future Program of Highways, Roads, Streets and Bridges for California", based upon facts and findings of the California highway planning survey which had been carried on for a dozen years (*ENR* Nov. 7, 1947, vol. p. 609). The study brought together the engineers and other officials of the state, cities and counties, to coordinate their needs and to formulate a sound, long-range program.

While the engineering study was proceeding, the legislative committee held public hearings throughout the state and created an advisory committee of highway users. Also, the committee arranged for a special report by a consultant on fiscal and tax policies. Then, early in 1947, it reported back to the legislature.

As a result of the work of that committee, the last session of the California legislature enacted the Collier-Burns law, a milestone in the highway history of California. It improved the administrative processes in state and local government; it recaptured funds that had been diverted and concentrated them on roads of general motor use; and it created a comprehensive ten-year program of improvement for that state. This work should put California in the forefront of all states in highway improvements during the next decade.

In Michigan, a special committee of the Michigan Good Roads Federation has concluded a study of the highway transportation problem of that state (*ENR* Feb. 19, 1948, vol. p. 239). Similar studies are being made in Arkansas, Connecticut, Kansas, Kentucky, Illinois, Maryland, Massachusetts, Missouri, Mississippi, Oregon, Pennsylvania, Tennessee, Vermont and Washington, and many other states are contemplating similar action in the near future.

To review, today's highway usage is staggering; tomorrow's will be more so. The job ahead is so big every road dollar must be made to bring full value; there must be no waste. There is no place for dispersion or thin scattering of road funds, and there is no place for diversion. But there is plenty of room for facts. And with the states, and their cities and counties, stepping up to the challenge, there is every reason to believe that the future holds forth not only expanded highway travel, but a more economical and safer travel.

By their increasing use of the motor vehicle and by the opinions they express in many ways, the American people demonstrate their approval of continued highway development.

It has been the privilege of the Automotive Safety Foundation, by the loan of engineering staff services, to participate in the fact-finding studies of a number of states. This participation is based on the belief that only through the development of long-range highway programs, embracing sound principles of planning and administration, can the public interest be served.

County and City Governments Merged in Baton Rouge

By merging its city and county governments, Baton Rouge recently became one of the few U. S. localities with a genuinely unified local administration the International City Manager's Association reports. It was effected by voters' approval of a new charter joining the governments of city and parish. A parish is the Louisiana equivalent of a county.

Under the new charter, the entire parish will be governed by a council of nine, seven of the members elected at large from the urban area or city. The council will select from its own number a parish president to be titular head of the city and parish governments. The chief administrative officer will be a city-parish manager.

The new government will provide city services to the entire parish area through unified departments of public works, purchasing and finance. The civil service systems of city and parish likewise are joined under the new charter. Tax rates will be based on services rendered to each zoned area —rural, urban and industrial.

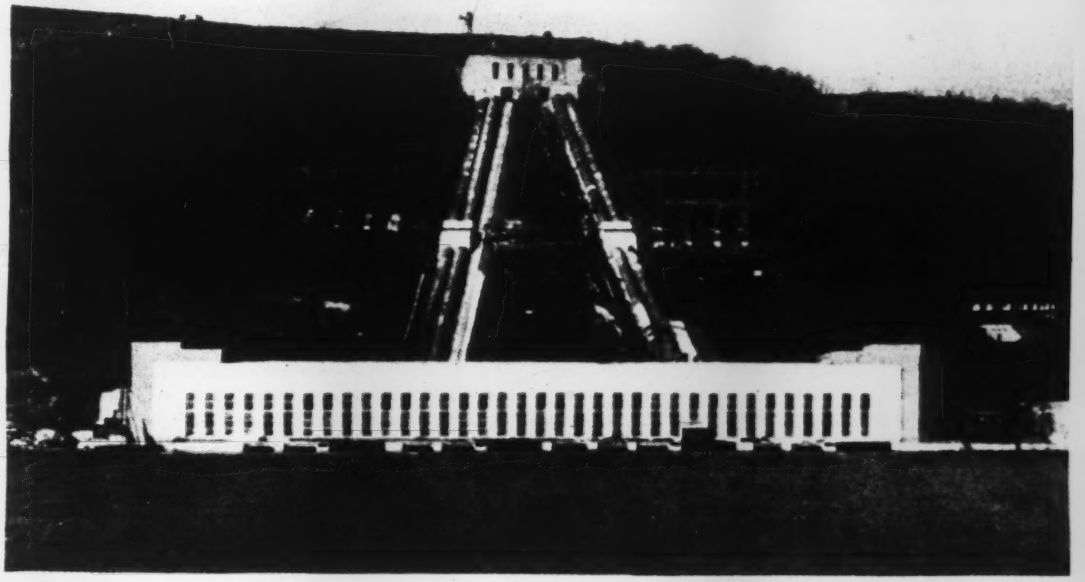


Fig. 1. Largest of existing pumped storage hydro-electric plants is the 194,000-hp. Herdecke plant in Germany.

Economic Possibilities of Pumped Storage Hydro-Electric Plants

N. N. Wolff
Hydro Engineer, Chicago, Ill.

***Contents in Brief**—Increasing power demands and mounting costs have stimulated interest in the economic possibilities of pumped storage hydro plants, which utilize off-peak power to store water at a higher level for use during periods of peak demand. Application of pumped storage has been limited in the United States, but Europe has had successful experience with some 40 installations. The author's analysis indicates, as a rough guide, that pumped storage is economically feasible up to a cost of $255 per kilowatt for 1,000 hours use per year.*

GREATLY increased demand for electric power in recent years has intensified the interest of power producers in economical generating methods. It appears that the time is now ripe to make a broader application of pumped-storage hydro plants, i.e., plants which pump water into high-level reservoirs, using low-cost off-peak power from steam or run-of-river stations, and draw it out to obtain high-value peak energy.

Development of pumped storage as a source of peak-load energy has been limited in the United States to a few installations. European experience has been more extensive. Table 1 lists a number of applications of varied size. The Rocky River plant in Connecticut was the first large U. S. installation. More are planned. Europe has about 40 pumped storage plants with a capacity of more than 1,000,000 kw. Most of them have operated with great success for many years and have proved their economic practicability.

Application of pumped storage

A pumped-storage hydro plant consists of a high-level reservoir connected by a penstock to a generating station at tailwater. Water is drawn from the upper reservoir at times of peak load, and pumps are operated by the generating plant in off-peak hours to raise water from the tailwater source to the headwater reservoir.

Pumped storage plants are of various types to accommodate local conditions. Most of them are of the daily pumping and regenerating type, but there are larger plants with seasonal storage. The high-level reservoir may be an existing lake or an artifi-

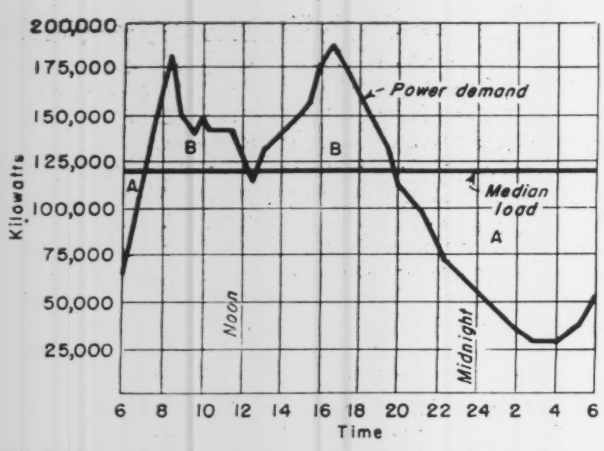


Fig. 2. Pumped storage improves the operating efficiency of a large power plant. Area A, below the median load line, is the pumping energy; area B above this line is the recovered energy. (From Revue Sulzer, 1930, Vol. 2-B, p. 17).

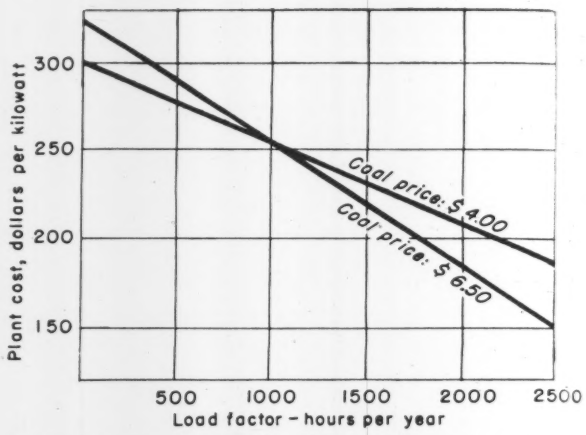


Fig. 3. Two cost limit curves indicate the economic feasibility of a pumped storage installation, assuming that all pumping is done by off-peak steam energy and that the kilowatt-hour cost of a steam plant is no greater than that of a hydro plant.

cial pond. Depending upon site conditions, an artificial reservoir, a river or a lake may serve as the tailrace.

It is possible to build a pumped-storage plant in a location where development of ordinary hydro power is out of the question. A plant of this kind is practically independent of rainfall. Because of the character of a pumped storage development, negotiations with authorities and landowners usually take little time and cause only short delay in starting work on a project. Construction cost is relatively low. No expensive river work is necessary; dams are mostly low and small. All these factors make it easier to find suitable sites in the neighborhood of power lines and power stations.

Existence of pumped storage plants of widely varied capacity, as shown in Table I, indicates the possibility of developing such plants for large electric utilities, small communities or individual industries. Power for operation is supplied by off-peak steam or surplus hydro energy otherwise wasted.

Largest existing plant

On the Ruhr River in Germany is the largest existing pumped storage hydro-electric installation, the Herdecke plant (Fig. 1) with a capacity of 194,000 hp. This plant, of the daily pumping and regenerating type, was developed by the Rhine-Westphalian Electric Power Co. to cover the peak load of its power system and improve the load conditions of the connected basic plants, mostly steam.

A Ruhr River storage reservoir serves as the tailrace. Water is stored in an artificial pond with a capacity of about 1,300 acre-ft. on a hilltop. The plant operates under a head of about 540 ft.

Four sets of machines are installed in the powerhouse on the bank of the tailwater reservoir. Each set consists of a spiral turbine, a pump and an electric unit which serves as a motor in times of pumping and as a generator during periods of regenerating. Between the generator and the pump is a coupling to switch the pump on and off.

As an example of load improvement through application of pumped storage, Fig. 2 shows the load curve on a winter day of maximum power demand at a large electric utility plant with a yearly output of 360,000,000 kw.-hr. The minimum load is 27,000 kw., and the maximum is 189,000 kw. A straight horizontal line indicates the median load with daily pumping and regenerating in effect. Area A indicates the energy needed for pumping; area B, the energy obtained by regenerating. Area A is larger than the sum of the B area, the difference being the operating loss. Income from peak load energy is several times as great as expenses for pumping.

Economical cost limits for construction of pumped storage plants

TABLE I. PUMPED STORAGE HYDRO-ELECTRIC PLANTS

Name	Capacity, hp.	Head, ft.	Upper reservoir, acre-ft.
United States			
Rocky River (Conn.)	32,000	230	140,000
Lake Lamoka (N. Y.)	2,500	396	4,700
Europe			
Tuebingen	292	375	5.5
Ueberlingen	600	305	1,240
Zweribach (industrial plant)	800	1,500	5.5
Reutlingen	2,000	400	33.5
Mittweida	2,250	390	180
Friedingen	2,250	530	26.5
Tremorgio	12,000	2,900	Lake Tremorgio
Helm-Furth	23,580	135	....
Schwarzenbachwerk	62,500	740	12,500
Niederwartha	120,000	435	....
Schluchsee	184,000	435	....
Herdecke	194,000	540	1,300
South America			
Maitenes (Chile)	3,000	233	....

as compared with steam plants are indicated by Fig. 3. This graph is based on two fundamental premises: (1) that all pumping is done by steam off-peak energy and (2) that cost per kilowatt-hour of a steam plant is not more than that of a hydro plant. Each curve is a function of coal price and construction costs for January, 1948.

For the coal prices shown, the curves indicate the cost limit per kilowatt of a pumped storage plant at different load factors. For 1,000 hours use per year of energy from pumped storage (i.e., at a load factor of 11.4 percent), the construction cost limit per kilowatt is $255. At a lower load factor, the cost limit is higher. For higher load factors, the limiting cost has to be lower.

In explanation, it may be stated that the economic limit for pumped storage plants goes up as the load factor decreases because it costs a steam plant more to switch boilers on and off for short periods than to keep them under steam for longer periods. For a low production factor (less than 1,000 hours annual use), the limit rises when the price of coal increases.

As the peak load factor is generally between 5 and 15 percent, the price of $255 per kilowatt approximates the economical limit of a pumped storage plant. Cost, of course, depends largely on local conditions, and the diagram furnishes only a rough guide.

Many possible sites

Studies and investigations which the writer has made of a number of sites in different parts of the United States lead to the conclusion that many locations offer attractive possibilities for pumped storage plants and that the construction cost of these plants would be far below the economic limit already mentioned. To illustrate, some figures may be cited on a proposed plant recently worked out.

For this plant, the site is on a river with ample pondage, near a large city and about 1½ miles from a transmission line. A head of about 430 ft. and storage of about 550,000 kw.-hr. are available, using an adjacent valley as the high-level reservoir and the river as the tailrace. The valley can be closed by low dams.

Generating capacity of the plant would supply a peak load of 25,000 kw. for 20 hr. or 50,000 kw. for 10 hr. Construction cost of the development is estimated on a basis of a complete power station structure for two 25,000-kw. units with either (1) initial installation of one unit or (2) installation of two units. Estimated total cost is $150 per kw. for proposal (1), and $110 per kw. for alternate (2).

North Carolina Builds Highway Turnouts

In constructing new highways in North Carolina, permanent turnouts are being built on a fairly frequent spacing to permit trucks and other traffic to park off the pavement without damaging the shoulders. Past experience in North Carolina has shown that trucks frequently stop along the highway to permit the driver to rest for a short time and that the shoulders are often damaged by heavily loaded trucks.

Now, in building new primary roads, the state highway department is widening the grading at frequent intervals to provide convenient places for the drivers to stop. By careful selection of the turnouts, little additional grading is required, and surfacing the area with crushed stone, gravel, or selected material adds little to the cost of the job. Generally no attempt is made to pave the turnouts, but this has been done in a few cases where usage is heavy.

Spacing of the turnouts varies with the location and importance of the road being constructed and the percentage of truck traffic the new route is expected to carry. On roads planned to accommodate heavy truck traffic the turnouts are spaced between two and five miles apart.

They are usually placed on tangents and where good sight distances in both directions are available. An attempt is also made to select a spot where shade trees are available, which adds greatly to the value of the turnout for passenger car traffic.

Turnouts are being built along main highways in North Carolina to provide places where cars and trucks can stop clear of the highway.

Turnouts used frequently

Construction of the turnouts as part of new roads was begun with initiation of the department's postwar building program. Experience to date shows that the drivers using the routes so improved soon learn of the turnouts and use them frequently. They are being built in addition to construction of scenic turnouts at locations where an exceptional view of the countryside is possible.

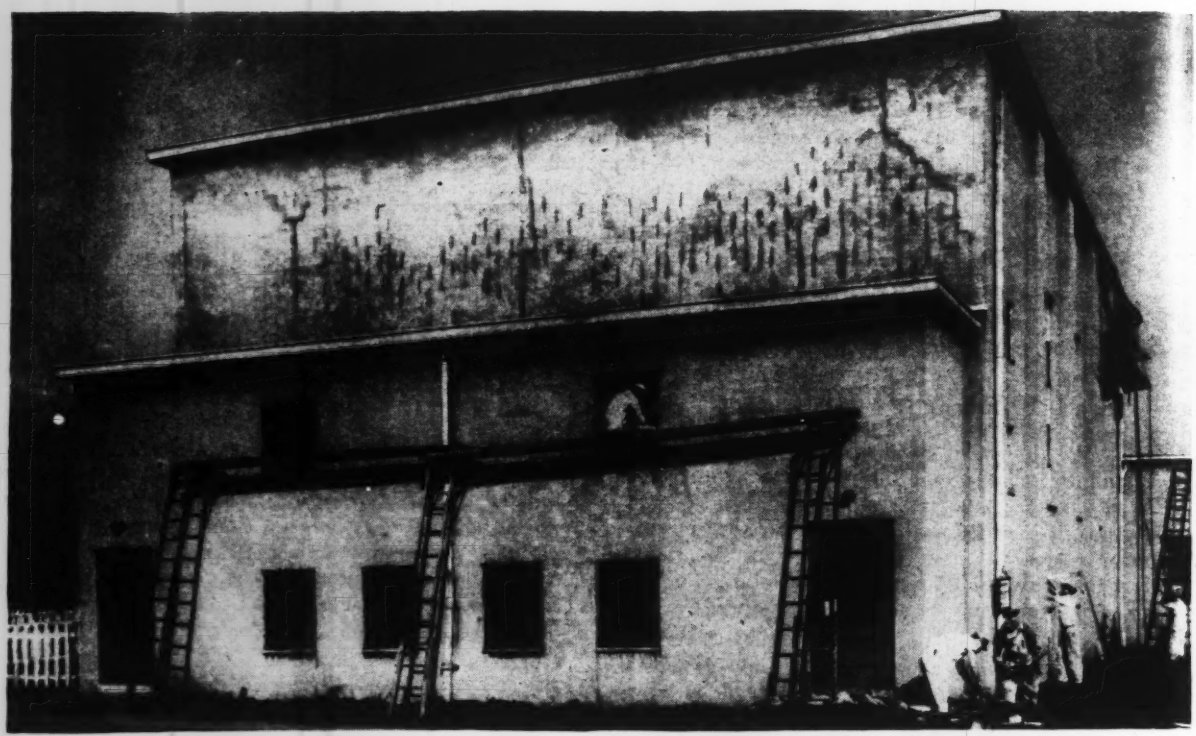


Fig. 1. Before weatherproofing—concrete-block houses suffered progressive joint separation and surface deterioration.

Weatherproofing Concrete-Block Houses

Contents in Brief—On a housing project in Cleveland, Ohio, a tough maintenance job was licked and concrete restoration was simplified by applying a mastic-cement coating with job-developed portable spray equipment.

WITH the use of concrete blocks for construction of dwellings—particularly the multi-family type—continuing to increase as a result of shortages in brick and skilled labor, certain maintenance problems appear destined to command correspondingly greater importance for both public housing officials and individual property owners.

One such job is curbing and controlling motar-joint separation and the deterioration resulting from moisture seepage between blocks due to excessive interior condensation and extreme temperature variations. Considerable expense may be entailed in checking this disintegration unless two essential requirements are met. They are: (1) a "weatherproofing" protective finish coating especially designed for this particular type of building maintenance work, and (2) a time-saving technique of application that substantially helps keep total job cost within a reasonable figure.

An example that demonstrates the economic value of such a basic combination in expediting concrete block restoration is provided at Carver Park in Cleveland, Ohio, where 31 two-story apartment buildings, 14 houses and the community center have been given a mastic-cement protective coating. The project is operated by the Cleveland Metropolitan Housing Authority.

Back of the final solution for the restoration of these four-year old houses lies an interesting history. The problem first cropped up in the winter of 1944, a year after completion, when the original cement-water paint washed off, stripping the concrete blocks of protection against weathering. In addition, because of excessive interior condensation in some suites, moisture had started to seep between the mortar joints of the blocks in certain areas, particularly those beneath and adjacent to windows. Mortar joints had cracked and separated in various places from expansion and contraction of the buildings.

Eight compounds tested

Thus, the problem became twofold: (1) to eliminate this disintegrating condition, and (2) to restore the damaged areas to like-new condition. It was tackled in various ways. First, an attempt was made to waterproof the joints and seal them with a cement-water paint. This failed, and joints continued to open up.

An extended "exposure test" was

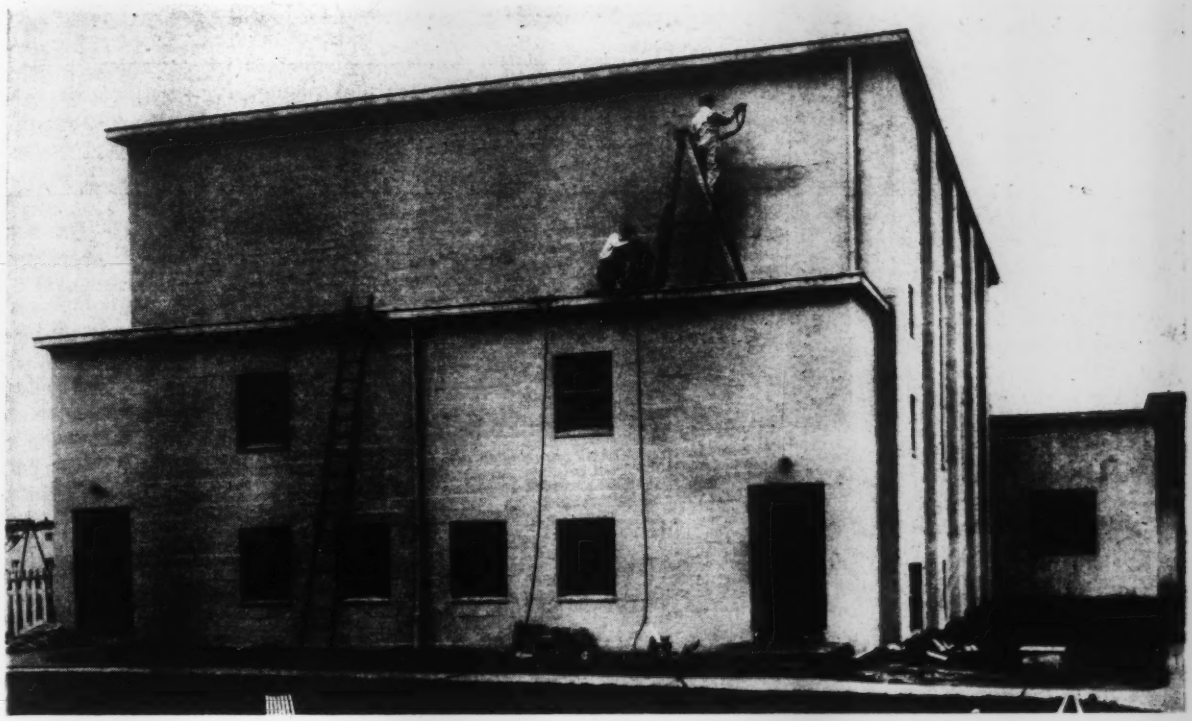


Fig. 2. Weatherproof mastic was applied by a job-made spray gun on the previously primed and caulked concrete surface.

made with eight different types of waterproofing compounds. Sample walls of certain buildings where deterioration was most pronounced were selected for the test. Each was covered with a different compound, and remained exposed to the weather for the greater part of 1945.

After several months' exposure two of the waterproofing compounds proved superior in checking moisture seepage and mortar-joint separation. Two contracts were awarded, using these two compounds. One contract covered 14 of the houses. The other included the remaining 31 apartment buildings and the community center.

Spraying cuts application time

Details of special equipment and methods employed in applying the mastic weatherproofing on the 31-apartment contract were as follows:

Although the mastic-type cement coating used on this contract readily lent itself to application by spraying, instead of the usual hand-brushing method, special equipment was needed for its application.

This job-made, portable spray outfit included a spray gun with a ¼-in. nozzle, especially designed to handle the mastic weatherproofing. In addition there was an air compressor of 30-cfm. capacity at 100 psi., together

Fig. 3. After the concrete-block walls were thoroughly cleaned by wire-brushing they were primed with a water-repellent primer (at left), open mortar joints were caulked (at center), and the mastic-cement coating applied by spray gun (at right).

with a 15-gal. pressure tank. The spray gun used 26 cfm. of air at the required pressure.

Total cost of the portable spray outfit, including necessary rubber hose for compressed air and the solution, was $3,500. This outfit permitted positive yet flexible control of material flow regardless of temperature, within the prescribed limits under which the mastic was applied. Air pressure could be stepped up or down as desired, and the spray outfit reportedly saved up to an estimated 50 percent of the time that would have been required by hand-brushing.

The contractor found that best results were secured by having the concrete-block as dry as possible when applying the mastic waterproofing. First operation was to remove, by wire brush and hand scraper, all dust, grit and loose concrete scale from the face of the concrete block, and all deteriorated mortar from the joints.

All cracks between mortar joints and those adjoining areas to be repaired were given a primer coat using a water-repellent, oil-base priming compound. Mortar joints then were calked with an asbestos-fiber, oil-base compound, following which the entire area to be repaired was given a primer coat preparatory to applying the mastic. The primer coats were applied with an ordinary paint brush, and the calking by trowel.

Three-man crew

A three-man crew applied the mastic waterproofing at an average rate of one gallon per 25 sq.ft. of area covered. One man operated the spray gun, the second filled and maintained the material supply tank, while the third man took care of masking, surface cleaning and moving the scaffold. This crew covered about 2,500 sq.ft. of building surface per day, including surface cleaning, priming and calking. Each building was completed in a total of nine days, barring interruptions due to adverse weather.

Contractors on the job

Cleveland Commercial Painting Co., Cleveland, Ohio, held a contract for weatherproofing the 31 apartment buildings and the community center. This company, headed by Paul Fleming, also developed the portable spray outfit. All weatherproofing materials on this contract, including primer, calking compound and the final mastic coating were furnished by the Arco Company, Cleveland, Ohio. The 14-house weatherproofing contract was held by Wiles-Deter, Inc., also of Cleveland, who also furnished their own weatherproofing materials.

Commission to Study Western International Waters

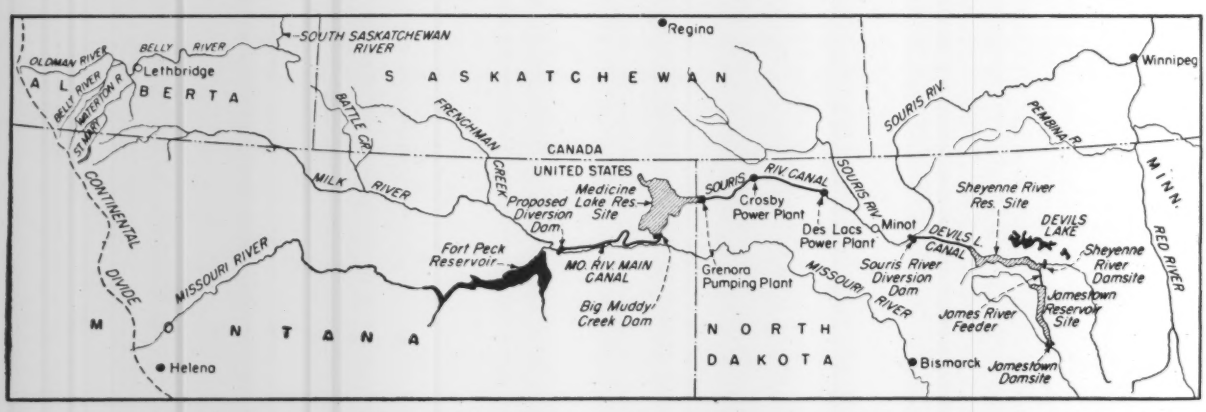
NEGOTIATIONS opened nearly two years ago by the U. S. and Canada looking toward the initiation of investigation by the two countries of the water and land resources along the international boundary from the Continental Divide to the Red River of the North (see map) were successfully concluded in January. At that time the two governments agreed to refer the matter to the International Joint Commission for detailed study and advisory recommendations.

It is expected that the commission's study will have great significance regarding construction projects being planned by the Bureau of Reclamation to utilize the waters of the Missouri and Souris rivers, and the plans of the Canadian Ministry of Mines and Resources for utilization of the waters of the Saskatchewan River and other streams.

Much territory involved

At the western end of the boundary section, the study concerns the flow of the Waterton and Belly rivers, two streams rising in Glacier National Park and carrying annually about 700,000 acre-feet of water into Canada. Discharge of the St. Mary and Milk rivers are not involved, but the investigation does include the flow of all international streams between the eastern edge of the Milk River drainage basin and up to and including the Red River on the east.

The International Joint Commission—United States and Canada—now has charge of the study, working under provisions of the Boundary Waters Treaty signed at Washington, Jan. 11, 1909. The study will be conducted under Article IX of the



Now under study by the International Joint Commission is control of the flow of several of the rivers crossing the international boundary between the Red River and the Continental Divide. Included will be changes in the regimen of the Souris River resulting from the proposed diversion of water from the Missouri below Fort Peck Dam into the Souris River basin.

treaty which provides for an advisory finding at an early date.

The 1909 treaty covers flows of the St. Mary and Milk rivers and it also set up the International Joint Commission to deal with all future problems regarding streams of common interest to the two countries, plus a wide variety of other problems arising between the two countries. It did not, however, allocate the flows of the Waterton and the Belly rivers. Montana interests would like to be able to use their share of the flow of these rivers, but to do so it might be necessary to construct tunnels located entirely on United States soil, which is physically possible, although other means may be studied during pending investigations.

Reclamation plans big job

Among the projects being planned by the Bureau of Reclamation in the vicinity of the international boundary is the big Missouri-Souris Unit of the Missouri Basin project. This unit was authorized for construction by the Flood Control Act of 1944, and detailed investigations and preconstruction activities are now going on.

About 1,250,000 acres of potentially productive lands in Montana and North Dakota would be put under irrigation under this plan. The water would be diverted from the Missouri River below Fort Peck Dam (see map) through a canal of 6,200-cfs. capacity into a large reservoir on Big Muddy Creek (Medicine Lake Reservoir). At the eastern end of this reservoir near Grenora, N. D., one of the largest pumping plants in the U. S., a plant of 12,000-cfs. capacity pumping against a 100-ft. head, would deliver water to a second canal of 12,000-cfs. capacity delivering to the Crosby-Mohall area of about 1,000,000 acres in the Souris River basin.

Excess waters and return flows would be diverted from the Souris River through a third canal to the Sheyenne River, a tributary of the Red River, and a portion would thence be diverted through a fourth canal to the James River, an eastern tributary of the Missouri. Various areas would be irrigated along this route by pumping and gravity diversions.

Two seasonal power plants are also included in the plan, along with provision of municipal water supplies for several cities, recreational facilities, and fish and wildlife conservation. On the basis of Jan. 1940 prices, the entire Missouri-Souris Unit is estimated to cost about $137,600,000.

To assist in this work, the commission in April expects to appoint a six-man consulting board. Three of these men will be American engineers representing the Bureau of Reclamation, the U. S. Geological Survey, and the U. S. Army Engineers. The other three will be Canadians representing three engineering organizations of that country.

Other studies in progress

Several other studies of interest to the construction industry have also been referred to the International Joint Commission. These include three pertaining to pollution of international waters. Of these latter studies, one deals with the pollution of the Detroit and St. Clair rivers and St. Clair Lake in the Detroit, Mich., area; the second pertains to St. Marys River between Lake Superior and Lake Huron, and the third refers to Strawberry Island in Niagara River.

Other matters also referred to the commission include: A comprehensive study of the development of the Columbia River system; regulation of the waters of Rainy Lake and Namekin Chain of Lakes in northern Minnesota; division of the waters of Sage Creek in Alberta and Montana; application of the Creston Reclamation Co. to reclaim 8,000 acres adjacent to the Kootenay River in British Columbia; a plan of the Northern States Power Co. to erect a dam on the Souris River; and application from North Dakota to go ahead with the Hardie project, which calls for irrigation of 3,000 acres along the Souris River. Work has been under way for some time.

U. S. members of the commission are: A. O. Stanley, former senator from and governor of Kentucky, and Roger B. McWhorter, chief engineer of the U. S. Federal Power Commission. Canada is represented by J. E. Perrault of Montreal, a past attorney general of Quebec, and George Spence, former member of Canada's House of Commons, of Regina Sask.

Trickling-Filter Maintenance Costs

Maintenance of the trickling filter at the Fargo, N. D. sewage disposal plant cost a total of $12,431 or $1,036 per year for a twelve-year period ending in 1947. An analysis of the expenditures, recently published in a bulletin of the North Dakota Water and Sewage Works Conference, was prepared by Floyd Pinney, superintendent of the plant.

Since the plant was built, some repair work has been required every year. Steel work has been cleaned and painted four times in the 12-yr. period. Costs are broken down as follows: paints, $4,246; labor for cleaning steel and painting, $5,536; roof repair, $2,235; and new and larger ventilators, $414. Concrete repairs have cost less than $50. Nozzle replacement amounting to about $30 per year has not been included in the total maintenance figure.

To evaluate these costs, information on size and materials used in construction of the completely inclosed filter with stationary nozzles is required. The filter is 315x229 ft. in plan and covers more than 1½ acres. Footings, foundations and floor contain about 2,500 cu.yd. of concrete. Superstructure walls are built of tile and the built-up roof is supported by steel columns, beams and joists. There are 84 steel sash and ten steel doors.

Some of the causes for the rather high maintenance costs are found by examining operating conditions. Structural steel and wall tile deteriorate under presence of the excess moisture. Corrosion or oxidation of steel takes place even under the protective coating. Tile spalling is caused primarily by freezing-and-thawing. Hydrogen sulphide in the sewage is changed to either sulfurous or sulfuric acid in the filter. These acids attack the coatings of structural steel, steel sash and doors. Measured by the very low expenditure for repair, the concrete work appears to have withstood chemical disintegration with success, Mr. Pinney states.

Air Jets Compact Concrete Around Reinforcing in Wall Forms

A SIMPLE pneumatic device that proved highly effective in compacting concrete in the forms without the aid of vibrators was used recently in construction of a six-story department store in San Jose, Calif. The building is entirely of reinforced concrete and in all walls and columns the pneumatic method was the only compaction method used. Vibrators of the ordinary type were used only in floor slabs and in the large foundation pours.

The pneumatic method of compaction is claimed to have special advantage in the narrow confines of wall forms, where there usually is considerable reinforcing, and in concrete columns. In such locations this method is said to effect the desired dispersal and compaction of the concrete without danger of disturbing bond around steel extending downward into parts of the pour where the concrete has already begun to set. Also the air jets do not distort the forms.

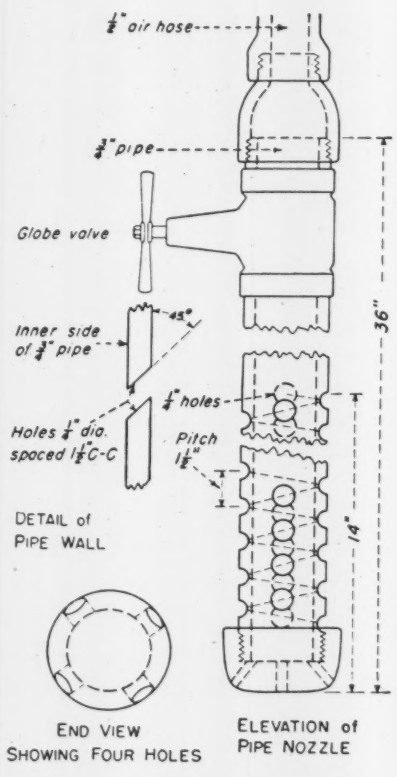
The air is applied in such a way that it bubbles up through the concrete, causing such thorough compaction that no air bubbles or pockets are left on the wall faces. As proof of the effectiveness of the air jet compaction, it is stated that when forms were removed on this San Jose job, neither inner nor outer faces required further finishing of any sort.

Air discharged upward

As developed by experiment on this job the device consists simply of a 3-ft. length of ¾-in. pipe with a cap over the outer end; holes are bored at optimum angle and spacing in half the length of the pipe. The 18-in. length adjoining the capped end is tapped by a large number of holes ¼-in. in diameter. These holes are spaced half an inch a part around a spiral that winds along a ½-in. pitch, thus making the holes so close that this portion of the pipe is almost a sieve. The holes are drilled at an angle of 45-deg. with the axis of the pipe so that when the pipe is held in a vertical position with the cap down the inclination of the holes directs the air jets upward. This facilitates return of the air through the concrete to the surface. Compressed air is delivered to the pipe through a ½-in. air hose.

Many arrangements tried

Before this size, arrangement and inclination of holes was selected a number of experiments were made, beginning with compressed air merely discharged from the open end of the pipe. Various sizes and spacings of holes were then tried with varying air pressures. The objective was to obtain a combination in which the concrete would receive just the amount of agitation that would make it possible for gravity to fill the forms tightly. It is necessary to do this without (1) seriously disturbing the concrete by too violent air jet action or (2) failing to provide for the escape of air. Failure to get the air out results in pockets and voids left in the concrete. The arrangement of holes described above and shown in the sketch, when used with a pressure of 30 lb. per sq. in., worked out most successfully and obtained the good results reported in the foregoing.



Arrangement of the ¾-in. pipe nozzle used for delivering air for compaction of concrete.

Experience in operating this pneumatic agitator brings out the suggestion that when it is withdrawn from the concrete this should be done rather slowly so that entrapped air has opportunity to escape. It is observed, too, that concrete should have at least a 5-in. slump to obtain best results with this method.

Nozzle for side delivery

Although this device is designed and recommended for use primarily in a vertical position, it was found on this job that it would "push" concrete rather effectively to one side as in forcing the concrete to move sideway under some obstruction in the wall forms such as a window frame. Because of the success of tests on horizontal movement, a somewhat different type of air nozzle was built and tried.

This consisted of a similar length of pipe of half-inch dia. and with only one opening for escape of air, namely, a ⅜-in. hole in the cap at the lower end. For this special function this pipe was bent through a right angle near the capped end so that when the pipe was held vertically a length of 7 or 8 in. of the tip would extend horizontally to one side. With this nozzle concrete was successfully "moved" in the 8-in. wall forms so that working in from both sides the concrete was compacted solidly in the wall beneath sills of windows 7 ft. wide where the sills were only 1 ft. above the previous pour. That is, the concrete was worked in a distance of 3½ ft. from either side of the windows. When forms were stripped the surfaces were as good as those reported elsewhere on the job.

Credit for originating the idea of the pneumatic agitator and development of its design as used on this job goes to Robert VanBriggle, assistant to E. V. Schon, superintendent on the job for the Dinwiddie Construction Co., the contractors. The building is being built for the firm of Roos Bros. Albert Williams & Associates are the architects; W. Adrian is the structural engineer.

BEGINNING A SERIES
OF ELEVEN ARTICLES ON
DEVELOPMENTS IN WATERWORKS PRACTICE

New Vistas In Water Quality Research

W. W. DeBerard
City Engineer,

John R. Baylis
Engineer of Water Purification

Department of Public Works
Chicago, Ill.

Contents in Brief—To develop faster and better methods of bacteria identification and water-quality control, the electron microscope is being applied to basic waterworks research. By enlargement of fine-grain negatives of electron-produced images, the electron microscope produces useful magnifications up to 200,000 times on solid materials and 50,000 times on bacteria. Preparation of a specimen, making the exposure and enlarging the negative can be accomplished in about two hours.

USING the electron microscope, pioneer waterworks research on the identification of bacteria and microscopic organisms, as well as the mechanism of coagulation, is being carried out in the laboratory of Chicago's South District filtration plant.

One research objective is to develop a procedure for rapid identification of coliform bacteria. If these bacteria can be seen under the electron microscope, the time-interval for determining presence of disease-producing organisms in water will be greatly shortened, and the waterworks operator will have a new tool for maintaining quality control.

In making plankton counts on water, algae and other minute particles examined under the light microscope are identified by shape. If electron micrographs of bacteria can be enlarged to sizes comparable to algae images, it may be possible to identify some coliform organisms by shape.

Photography, therefore, plays an important part in use of the electron microscope. For most bacteria, image magnification of 5,000 diameters is so small that identification by shape is difficult, but electron-produced negatives may be enlarged to 20,000-50,000 diameters. Photographs of this size are large enough to reveal shapes as well as other characteristics of bacteria.

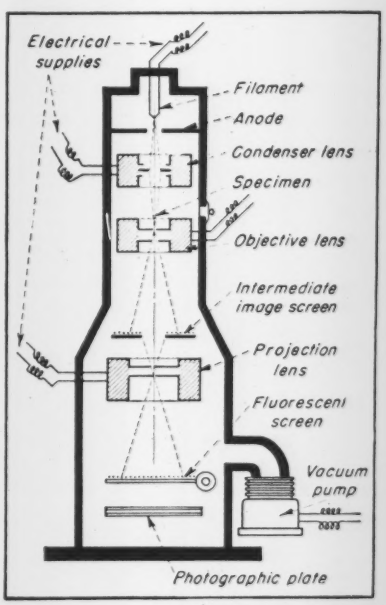


Fig. 1. Inclosed in a vacuum chamber, the electronic microscope consists of a source of irradiation, three electronic lenses, specimen holder, a fluorescent viewing screen, and photographic plate.

The electron microscope (Fig. 1) consists of a source of irradiation, an anode, a specimen holder, a system of electronic lenses, an intermediate image screen, a fluorescent screen for visual observation and a photographic plate for obtaining negatives of the image. These devices are inclosed in air-tight chamber and maintained under a high vacuum by a mechanical and an oil-diffusion pump.

Electrons shot through ring anode

The 30 or 50 kv. electron source, called the "electron gun," consists of an easily replaceable tungsten filament and a ring anode of heavy copper. The anode protects the specimen by removing much of the heat generated by electron bombardment and infrared irradiation.

Between the anode and the specimen holder a magnetic condenser focuses electrons on the specimen. Some electrons are absorbed by the specimen and others are scattered in all directions. Only electrons that pass through or close to the specimen with a large change in direction reach the photographic plate. A diaphragm in the objective lens removes most of the scattered electrons.

Specimens are supported on ⅛-in. discs of 200-mesh wire screens (Fig. 3) which are centered on the electron beam by a heavy steel ring. The ring is placed in the microscope through a gasketed port.

The magnetic objective lens, which

Fig. 2. Water quality research is being carried out at Chicago's South District filtration plant with a console-model electron microscope.

follows the condenser, is used for focussing; the projector lens, which follows the objective, governs magnification. Focussing and magnification are controlled by varying the strength of current in objective and projector coils or by altering shape and arrangement of pole-piece elements. Magnetic fields across the pole-piece systems are set up by electro-magnets.

Magnetic lenses are subject to aberrations and diffraction. Spherical aberrations are large unless angular aperture of illuminating beam is kept small compared to that used in light microscopes. By selecting a limiting aperture to produce equal effects of aberration and diffraction, these disturbances are minimized. In addition, it is important that exciting current and electron acceleration be almost exactly constant during photographic exposure.

Leaded-glass window for observation

The viewing chamber of the microscope (console model) is fitted with a leaded-glass window with a fluorescent inside surface. The 4-in. dia. window dissipates charges accumulated from electron bombardment and thereby prevents image distortion. The leaded glass shields the operator from random X-rays.

A photographic mechanism in the viewing chamber is rotated into the line of electron beam to make negatives of the image.

Within the air-tight chamber, the electronic beam operates under a high vacuum of 10^{-4} millimeters of mercury, or better. The vacuum is obtained by a ½-hp. mechanical pump operating in series with a two-stage, air-cooled, oil-diffusion pump, equipped with a 135-watt heater.

When the electron microscope is used, the pumps must be operated 15 to 20 min. before the required vacuum can be produced. After warming up, air let into the column for specimen and camera change is exhausted in 3 to 5 min.

When a specimen is inserted in the microscope, or a photographic plate is changed, filtered and dried air enters the column.

The time required for starting the machine, mounting the specimen, making and developing a negative, and then an enlargement, is two to three hours. Photographs are not made of all specimens. Many specimens are identified from the image on the fluorescent screen.

With the light microscope, an object 0.000008 in. long is about the smallest that can be seen because of the wave length of light. An electron beam has a wave length much shorter than that of light. Smaller particles, therefore, can be seen and photographed. A particle, 30 angstrom units (a.u.) in size (0.003 micron or 0.00000012 in.) is about the smallest that can be photographed with the electron microscope.

The resolving power—(the minimum distance apart at which two objects can be distinguished)— of the electron microscope at the Chicago waterworks is about 200 a.u. This is about seven times better than that of light microscopes. (The resolving power of the unaided eye is about 0.004 in.).

When the projector lens and high-gain insert assembly (console model) are not utilized in the electron microscope, magnification is about 500 diameters. One of our technicians prefers to work without the high-gain insert assembly and the pole piece holding the inner aperature. By so doing, a magnification of about 1,400 times is obtained. With a 10 to 1 or 15 to 1 enlargement, the specimen is magnified 14,000 or 21,000 diameters, respectively. A particle 30 a.u. in diameter must be magnified about 4,760 times and enlarged seven times (33,320 diameters) to be seen.

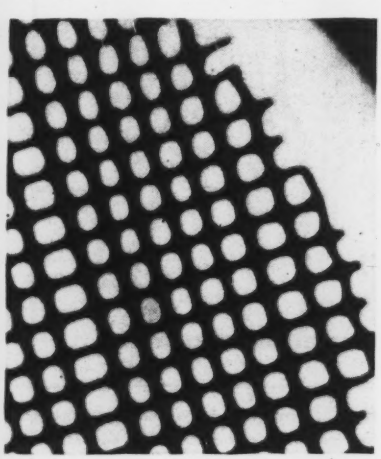


Fig. 3. Photo-micrograph of the 200-mesh specimen screen enlarged 38 times

Specimen-mounting technique

Specimens are viewed by transmitted electrons. The ideal condition is attained when some of the electrons penetrate the specimen. If the specimen is more than one micron in thickness, it generally cannot be penetrated. Specimens that are self-supporting are desirable because electrons pass only through or around the specimen. It is evident that bacteria and many other objects have to be supported.

Fig. 4. Partially transparent, this is Escherichia coli bacteria under 10,000 times magnification.

Fig. 5. Aerobacter aerogenes appear rather large when they are magnified to 10,000 diameters.

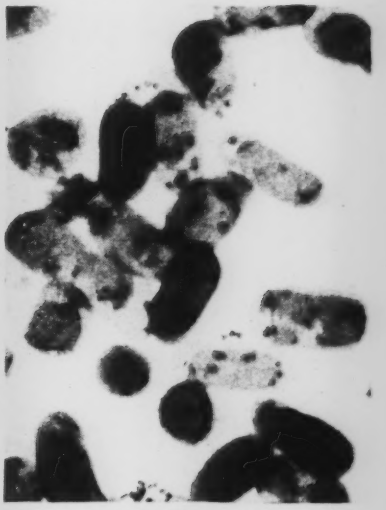


Fig. 6. Colonies of highly transparent Pseudomanas are seen under 10,000 times enlargement.

Formation of a suitable supporting membrane is not easy. It must be strong enough to carry its own weight as well as that of the specimen. It must be only a few molecules in thickness. The image produced by the membrane must be structureless and not too different from the image produced by empty space. Collodion and Formvar, obtainable in any laboratory supply store, are used in our work. Formvar appears to be more resistant to electron bombardment, but it is not as clear as Collodion. This condition may not obtain for all grades of the materials.

To prepare a membrane, a drop of 2 percent Collodion solution in amyl acetate or of Formvar is placed with care on the surface of distilled water in a vessel 8 to 10 in. in diameter. As drop spreads out, the amyl acetate of Formvar solvent evaporates rapidly, leaving a film floating on the water surface.

Several screen discs are then placed on the film, spread apart, but kept close enough for a glass slide to cover all screens. To collect the screens on one slide, a glass is held just above the water and moved downward so that the film folds up around the slide leaving the discs between the glass and film. The slide is lifted out and allowed to dry. The film is then ready for mounting the specimen by any one of several methods.

If the specimen is a colony of bacteria on an agar plate (about the size of a pin head), the colony is added to 1 to 5 milliliter of distilled water. This mixture is agitated by shaking until the bacteria are distributed evenly in the water. A portion of a large colony is sufficient for this purpose.

As little of the agar as possible is picked up. With an eyedropper, a small amount of the suspension is placed on the film-covered screen and allowed to dry.

No set rule can be given as to how much of a colony of bacteria should be added to each milliliter of water. It is better to make a strong suspension of bacteria and later dilute if bacteria on the film are crowded. Diluted too much, a specimen may be lost if the entire colony has been added to the water. Heat may be used to evaporate the water on the specimen film, but the temperature should be considerably less than 212 deg. F.

Bacteria from broth tests are used

Bacteria from broth tubes—such as those giving off gas in the presumptive test for coliform organisms in water—may be used. To mount a bacteria specimen, the broth tube is shaken and one drop is placed on the specimen film and allowed to dry. If bacteria are too numerous, the broth suspension may be diluted with distilled water. A good concentration of bacteria is generally obtained by using a drop of the liquid direct.

Residues in dried broth form a film that may interfere with electron transmission. This film can be partly removed by immersing in a mixture of 5 percent chloroform in absolute alcohol for 15 to 20 sec., drying, and immersing in a chloroform bath for a few seconds. After drying, the film is placed in a water bath for a few minutes and dried, with aid of a gentle heat. It is then ready for the microscope.

To mount the specimen in the microscope, the screen is removed from the glass slide and placed in the specimen-holder cap, film-side down. If the screen is turned over, it will cause some reduction in magnification, as the instrument is adjusted to a definite plane based on film held against the metal of the cap. The screen should be toward the electron beam at critical points where the film touches the wire. In this position, the screen serves as a heat-shield for points of support of the film.

Electron micrographs of *Escherichia coli*, of bacteria belonging to the *Aerogenes* group, and flagella of *Pseudomonas* bacteria are shown in Figs. 4, 5 and 6, respectively. The enlargements show that some electrons penetrate part of the cells. With others penetration is negligible and the photograph is mainly a silhouette of the organism.

A few cells of *Fragilaria* are shown in Fig. 7. The cells are too long to show the full length of the magnification used. In this micrograph,

Fig. 7. The saw-tooth edges of Fragilaria cells are revealed under 8,000 times magnification.

practically all electrons were absorbed by the *Fragilaria* so that only the silhouette of the organism is shown. An interesting feature of the micrograph is the saw-tooth edges of the *Fragilaria* organism. These edges are not revealed in the light microscope.

What can the electron microscope do?

Whether or not the electron microscope can be applied to routine differentiation of various kinds of bacteria, it is impossible to predict at the present time. The *Escherichia coli* and *Aerogenes*, while distinctive in shape from each other, may not be distinctive enough from other bacteria for positive identification.

Conclusions cannot be formed until the principal species of bacteria found in water have been isolated in pure cultures and photographed many times. Present indications are that a culture method—such as, the presumptive test for coliform bacteria—will be necessary. If at this stage of the test, positive classification of coliform or non-coliform bacteria could be made, it would be of considerable aid in water testing when early identification is desirable.

Present testing procedures are so long drawn ont that bacterial results are of little value in day-to-day operation. Their principal value is an historical one, to check on treatment effectiveness. Not much progress in shortening this time of identification has been made by bacteriologists in half a century. For varying treatment to eliminate bacteria—such as increasing chemical dosages, reliance has depended on secondary results. Maintenance of a chlorine residual is generally looked upon as a sufficient safeguard since dangerous germ-life cannot live in a water guarded with free chlorine.

If by new techniques bacterial-growth accelerators can produce recognizable coliform bacteria in a matter of hours, bacteriology would be of immediate help to the filter operator in setting treatment dosages. This might be too much to expect. But with the electron microscope an attempt can be made to achieve such control.

Puerto Rico Tackles Slum Clearance Problem

Puerto Rico's insular government is starting slum clearance independent of U. S. aid as a step toward solving one of the toughest housing problems in the Americas.

Though palm trees and slums don't fit together in most U. S. minds, the combination is grimly true for citizens of Puerto Rico, where population density is among the world's highest and families are 43 percent larger than in the states.

The National Association of Housing Officials reports that the Puerto Rico legislature this year appropriated $6.25 million for housing and passed a completely new slum redevelopment law. The legislature has granted $15.2 million for housing and slum clearance since 1944.

Most ambitious single project of the new program is the building of a new town, San Jose, on 550 acres purchased with public funds outside the capital city of San Juan. The new town will be developed by the Puerto Rico housing authority and will serve at least 6,000 families.

In San Jose those families will be housed who need new homes the most—namely, those currently living in the capital's largest slum nicknamed "Little Mud." The slum will be cleared to provide room for expansion of San Juan's port facilities.

Local housing authorities used

Under the redevelopment law, responsibility for housing developments is shifted from the municipal governments to the local housing authorities. Sites for several new projects already have been acquired. Under previous legislation, three housing projects have been completed, 10 are under construction, and 20 are planned for erection in the near future.

Public housing in Puerto Rico started with U. S. money and guidance. In 1938, the Puerto Rico housing authority and city authorities in San Juan, Ponce and Mayaguez were appointed to take advantage of the U. S. Housing Act. Since then, 4,850 dwellings in 14 cities have been built by the four agencies.

Acute need for raising housing standards despite poverty of the people has tested the ingenuity of Puerto Rican housing officials. A unique land-utility project in Ponce indicates a necessary compromise. A subdivision was provided with water and sewer lines, into which were moved not only slum dwellers but also their homes.

Concrete outhouses were placed at the intersection of every four lots in the Ponce project, providing each family with a shower head, water faucet and other facilities. Rents ranging from 50 cents to $4 a month are planned to fit the $600 a year average cash income of the Puerto Rican worker-family.

Sulphur Dioxide Cleans Filter Sand in Place

Sulphur dioxide is used to clean filters without removing sand at the 12 mgd., water-treatment plant of the West Virginia Pulp and Paper Co. at Luke, Md., which processes water for manufacturing purposes as well as for the town. This practice was described at a recent meeting of the North Dakota Water and Sewage Works Conference by John P. Harris, Chicago representative of the paper company's industrial chemical sales division.

Use of sulphur dioxide to clean sand filters at regular intervals improved operation in five ways:

1. No floc or dirt is drawn through the filters on over-capacity runs.
2. Mud balls are dissolved.
3. Uniform distribution of wash-water through the collector pipes is maintained and localized upward jetting that may cause a loss of sand into the wash-water troughs is eliminated.
4. A lighter sand color results, indicating a loss of grain coating, and therefore buoyancy.
5. Filter runs are extended 25 percent.

As a result of mine drainage from a coal-producing district, the raw water drawn from the Potomac River contains considerable amounts of iron and manganese. At times the pH is as low as 3.3 or 3.5. Consequently, "mud balls" of encrusted iron and manganese build up in the sand, loss of sand made buoyant by coating increases during washing and filtered water is roiled occasionally by iron bacteria breaking loose from underdrains.

Underdrains treated

Following encouraging experiments aimed at finding a remedy for these conditions, one filter was cleaned with sulphur dioxide. This trial demonstrated that cleaning could be accomplished effectively without removing sand from the bed. Moreover, the treatment cleaned underdrains, a benefit that would not have accrued had the sand been removed.

Before sulphur dioxide is applied, the filter is washed thoroughly, and possibly rewashed to insure a maximum of physical cleanliness. The water level is then drawn down into the gravel and the effluent valve as well as pipe connections across the Venturi and other meters is shut off.

After preparatory cleaning, a tank of liquid sulphur dioxide is attached to the effluent header by a brass pipe or hose with brass fittings and standard chlorine-tank connections. The sulphur dioxide is then introduced to the header preferably as a liquid by inverting the cylinder. In this fashion a 150-lb. container can be emptied in about 10 minutes. The amount of sulphur dioxide to be applied to a filter is determined by test.

With the injection of the chemical into the water, sulphurous acid is formed which is forced into the underdrains and up through the gravel and sand to a point 6 in. above the sand. Where possible, recirculation of the water-sulphurous acid mixture through the filter by a pump connected to the underdrains provides a maximum of cleansing, Mr. Harris said.

After the proper contact period (found from test), the filter contents are run to waste, and the filter is washed several times to eliminate all traces of sulphurous acid in the effluent. This is determined by resumption of normal pH value.

Careful handling required

Considerable care should be exercised in handling sulphur dioxide. However, at the Luke, Md., plant it was found that sulphur dioxide is much less corrosive and troublesome to handle than other harsh chemicals —such as, sodium-hydroxide and acid solutions.

Before sulphur-dioxide cleaning of filters is employed, it is recommended that laboratory tests of the sand and water be made to determine if this form of treatment is adaptable. Mr. Harris pointed out that "all water conditions do not lend themselves to this particular method of filter cleaning."

Another recommendation made by Julian G. Patrick, chief chemist of the Luke, Md. plant and originator of the sulphur-dioxide cleaning process, is that: "filters should be cleaned frequently with small doses rather than wait for a badly clogged bed which demands harsher treatment."

SULPHUR-DIOXIDE PROCEDURE FOR CLEANING FILTER SAND

In response to the editor's request, Julian G. Patrick, chief chemist, West Virginia Pulp & Paper Co., Luke, Md. gave the following instructions for determining how much sulphur dioxide is required to clean a filter:

"To ascertain the quantity or concentration of sulphur-dioxide water (sulphurous acid) needed to clean the sand, gravel and underdrains, take representative samples of sand 6 or 8 in. below the surface. Store these samples in air-tight containers to prevent drying.

"Treat a series of portions of moist sand in bottles or glass beakers with concentrations of sulphur dioxide ranging from 0.5 to 3.0 percent. (A solution stronger than 3.0 may attack ferrous metals.) After 24 hr. contact, wash the sand thoroughly to remove the loosened coating. The optimum dosage is determined by appearance of treated sand or a chemical analysis of any residual coating.

"The quantity of sulphur dioxide to be used for the desired strength of solution is determined from the volume of water within the filter unit from the closed effluent valve to three-inch coverage above the bed. Voids in the sand and gravel are considered at 40 percent."

Detailed information concerning the use of sulphur dioxide for cleaning filter sand may be obtained from the Virginia Smelting Co., West Norfolk, Va. who is licensed to handle the process under a U. S. patent.

Modified Parshall Flume Combines Measuring and Mixing

Alfred J. Ryan
Partner

Clifford L. Morgan
Sanitary Engineer

Crocker and Ryan, Consulting Engineers
Denver, Colo.

***Contents in Brief**—By modifying a Parshall flume to perform the dual function of measuring flow and mixing flocculating chemicals, designing engineers brought about construction and operating economies in expansion of the Greeley, Colo. water-treatment plant. Flow is measured in the upstream section of the flume and chemical solution introduced above the sloped section is thoroughly mixed by hydraulic-jump turbulence. The measuring and mixing chamber was built at a cost of $1,575.*

A NOVEL METHOD of measuring raw-water inflow and mixing flocculating chemicals in a single structure was included in expansion of the Greeley, Colo. water-treatment plant. A modified Parshall flume, this dual-purpose structure solves the problem of chemical mixing at a minimum cost without use of mechanical equipment.

In design of the measuring and mixing flume, controlling factors required that flows ranging from 0.4 to 12.0 mgd. be recorded accurately, head-loss through the unit be kept at a minimum to gain maximum discharge from storage and thorough mixing be achieved by hydraulic-jump turbulence before discharge to settling basins.

The upstream or measuring section of the twin-service unit is that of a standard Parshall flume (Fig. 1). With a 2-ft. throat, this portion of the structure measures flows under heads varying from 0.2 to 1.7 ft.

To prevent throat submergence during low flows and interference in the measuring section, the throat elevation at the control point was set 0.5 ft. above maximum tail water as determined by weirs to settling basins.

Upstream head is conveyed to a float tube in the operating building which actuates an indicating-totalizing-recording meter.

Since water in a Parshall flume passes through a critical depth at the control section (at the upper end of the throat), modification of the lower section does not influence the upstream head. The tail-water section of a standard Parshall flume recovers energy released by water after passing the critical-depth section. Consequently total head-loss measuring and mixing through the flume is kept at a minimum.

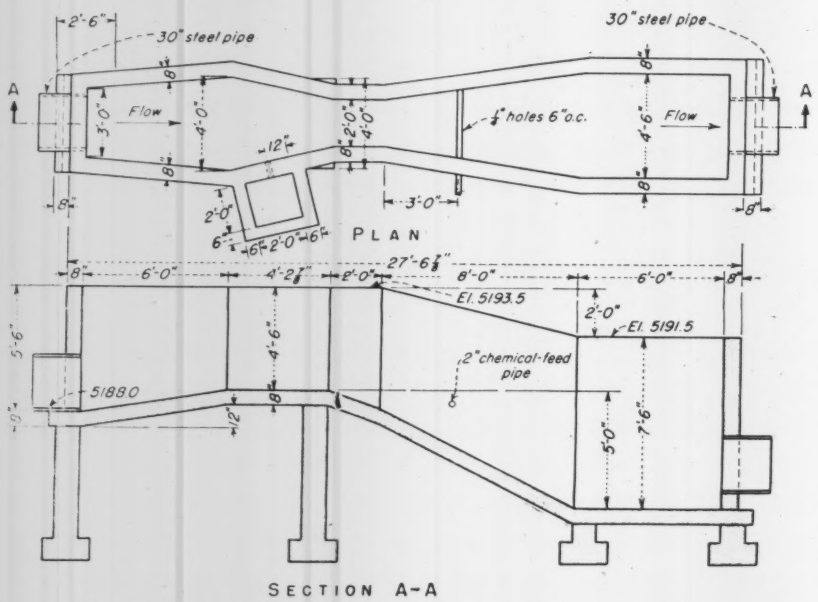


Fig. 1. Flow is measured in the upper section (left) and chemicals sprayed from a perforated pipe above sloped section are mixed by hydraulic-jump turbulence before the water is discharged to the settling basins.

Sloped section extended

In the downstream or mixing section the inclined floor is extended to lower the recovery channel. This extension permits formation of a complete hydraulic jump on the slope under all flows. As the incoming flow varies, the hydraulic jump moves up or down on the sloping section as determined by energy of the falling water. Elevation of the bottom of the incline was set so that hydraulic jump would occur at the toe at the maximum flow of 12.0 mgd.

Since the lower section of the flume is utilized to create turbulence, rather than to dissipate energy, a long stilling chamber is not necessary. The length of the lower section was arbitrarily set at six feet.

The flume feeds into a 30-in. pipe-

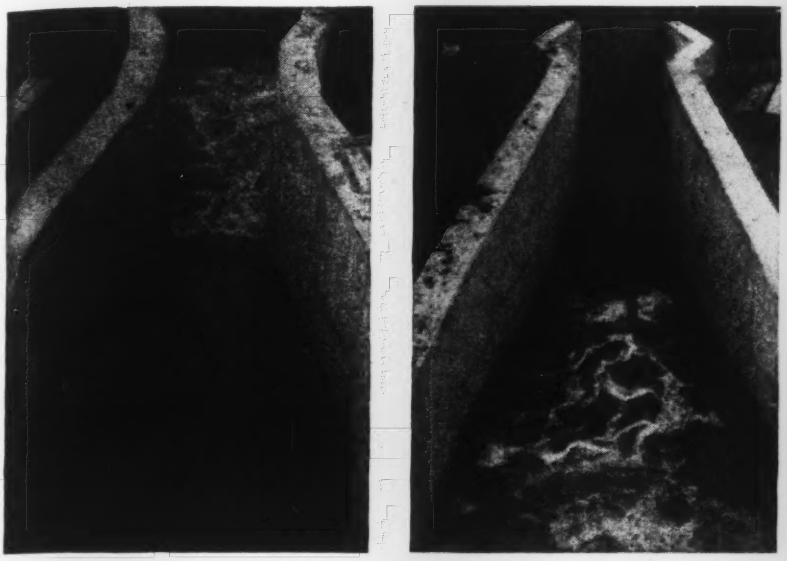


Fig. 2. Modified Parshall flume discharging at the rate of 7.5 mgd. Looking downstream (left), the chemical-feed spray pipe can be seen in the turbulence. The measuring section is shown looking upstream.

line which stills out the turbulence ahead of the flocculating basins. Water depth in the hydraulic-jump section of the flume is nearly constant under all flow conditions since it is controlled by overflow weirs at the ends of the settling basins. Over the 35-ft. weirs depth varies but a fraction of a foot for all flows.

Located above the incline, the chemical-feed line (Fig. 2) sprays solution into the water at a point about one-third of the distance down the slope. This position permits free solution discharge under all conditions except very low flows.

Discharging at 7.5 mgd., the flume is shown in Fig. 2. When these photographs were taken, the water elevation in the downstream section was about 0.5 ft. higher than normal because adjustments were being made to the settling-basin effluent control weir.

Operation is satisfactory

The structure is entirely satisfactory and meets all operating conditions. During the testing period, accuracy of the measuring flume throughout the range of 0.4 to 12 mgd. was found to be consistently within plus or minus one percent. Mixing action of the hydraulic jump is very powerful with a pronounced back-roll.

Another benefit from this type of mixing, though not considered in the design, is complete aeration of raw water due to hydraulic-jump turbulence. This action should be effective when raw-water aeration is necessary to release odor or carbon dioxide.

The complete measuring and mixing structure was built at a cost of $1,575.

Additions to the Greeley filter plant were constructed by the A. S. Horner Construction Co. and James B. Kenney Construction Co., both of Denver, Colo. The engineering was done by Crocker and Ryan, Denver, Colo. for whom Edward Kluck was resident engineer. Roy Seaman is water superintendent for Greeley, Colo.

Radioactive Bench Marks for Subsidence Study

A system of radioactive bench marks is being used in oil well bore-holes by the Long Beach, Calif., Harbor Department to aid its study of subsidence in the Long Beach area (*ENR* Aug. 23, 1945, vol. p. 239). The subsidence has approached a rate of 1 ft. a year in some locations. Opinions differ as to the cause of this movement.

Some of the suggested explanations include: (1) the consolidation of shales adjacent to oil-producing sands in the oil field underlying the area; (2) the consolidation of the producing oil sands; and (3) the effect of tectonic forces.

The bench marks have been placed at significant horizons in underground strata so an indication can be given regarding which of the strata are consolidating and causing the subsidence. This information should permit a more accurate analysis of the subsidence cause to be made than has been feasible up to this time.

The equipment used was specially developed in oil-well work for perforating casings and has been in use for a number of years. However, this is believed to be the first application in consolidation studies. Bullets, each containing a small pellet of a radium salt (half-life 1,600 years), were fired into the wall of the oil well bore prior to casing operations. Location of these bullets are indicated by use of a Geiger-counter type of instrument suspended on a steel cable and lowered into the well.

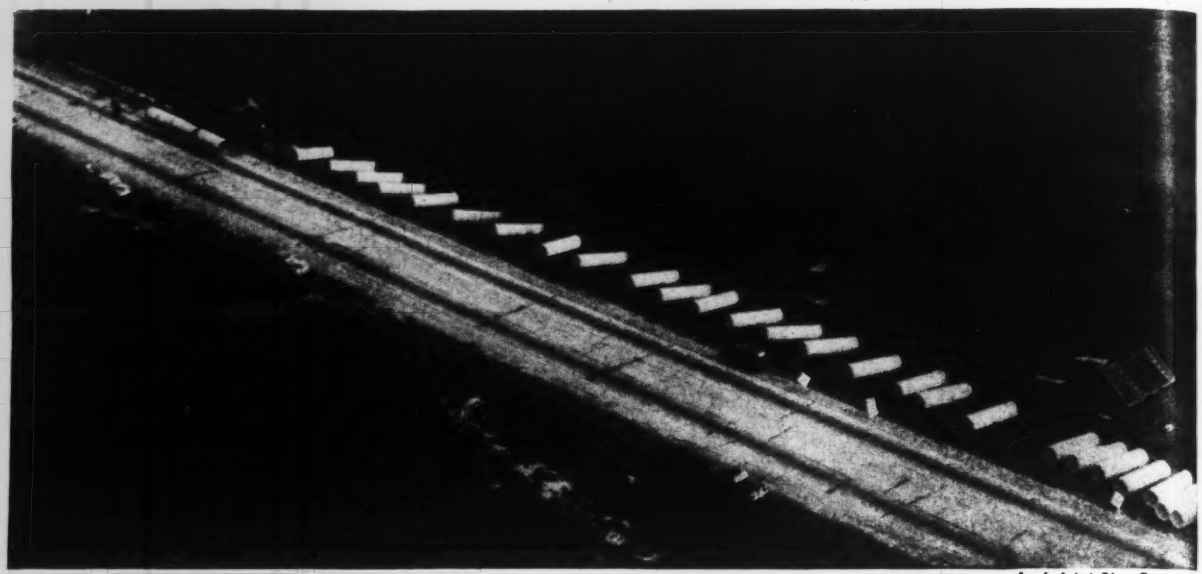
Radium pellets to be located

Later, when it is desired to remeasure the location of these bullets, this can be done in a similar manner. Such measurements are made by temporarily suspending operation of the well or during periods of shutdown for maintenance, repairs or inspection.

Measuring equipment is accurate to less than 1 ft. Because of this limited accuracy, it may take a number of years to get a fair indication of the particular strata that are consolidating. However, it is planned to check the location of the bench marks at least once each year.

Such bench marks were installed in four wells in the Long Beach area. About 20 of them were placed in each well at depths varying from 100 ft. to 5,800 ft.

The placing and locating of the radioactive bench marks was done by the Schlumberger Well Surveying Corp. of Houston, Texas, for whom Fritz Taves is West Coast manager. R. R. Shoemaker is chief harbor engineer of the Long Beach Harbor Department and Tom Thorley represented the department on this work.



Lock Joint Pipe Co. photo

Fig. 1. Existing highways furnished most of the right-of-way for the $12,000,000 Saginaw-Midland water line project.

80-mi. Pipeline Taps Lake Huron

***Contents in Brief**—Saginaw and Midland, Mich., have joined forces in the construction of a 78-mi. concrete pipeline to tap Lake Huron for a new source of water supply. The intake crib is to be located 2 mi. offshore at Whitestone Point, and water will be pumped by two 70-mgd. stations. The $12,000,000 project is scheduled for completion late this summer.*

RESIDENTS of Saginaw and Midland, Mich., accustomed over the past two decades to drinking the treated and filtered but bad-tasting waters of the Saginaw and Tittabawasse rivers, soon will be receiving their entire supply from Lake Huron. This is being made possible through the installation of 78 mi. of concrete pipeline and 2 mi. of steel-pipe intake. When completed, sometime this summer, the $12,000,000 pipeline and pumping stations not only will provide a more potable water, but it also will insure an adequate supply for both cities for at least 50 years.

Credit for the successful conclusion of Saginaw's forty-year old dream of tapping Lake Huron for its water supply is due in large measure to the cooperation of both cities in planning, financing and construction of the project. It marks the first instance where two Michigan cities have developed a water supply as a joint venture.

Briefly, the project includes a timber crib submerged on the bottom of Lake Huron, 2 mi. offshore at Whitestone Point, Mich.; 2 mi. of 66-in. steel pipe intake line; a 70-mgd. pumping station at Whitestone Point; 48 mi. of 48-in. concrete pipe terminating at a "Junction" pumping station of 70-mgd. capacity and a 5-mg. reinforced concrete reservoir.

From the Junction pumping station, one branch line of 36-in. concrete pipe extends 14 mi. south to the Saginaw filtration plant. A second line of 36-in. concrete pipe runs 13 mi. west to a connection with the Dow Chemical Plant, followed by 3 mi. of 24-in. concrete pipe connecting with the Midland filtration plant. All concrete pipe is prestressed, and the entire line from crib to filtration plants is designed for a 300 ft. head of water.

Contracts for the entire project were awarded in October 1946. Construction of the pumping plants and concrete reservoir was started early the following spring, and concrete pipe-laying crews started working as soon as the frost had left the ground. By the end of 1947 the entire project was 75 percent complete. Barring unforeseen shortages in materials or operating equipment, water should start flowing through the lines late this summer.

Present plans call for developing the system for a total capacity of 43 mgd., with a minimum daily pumpage of 21.5 mgd. under a 150-ft. head. By the construction of two additional pumping stations between Whitestone Point and the Junction station the capacity of the system can be increased to 70 mgd., under a 300-ft. head pressure on the pumps.

Intake in Lake Huron

Decision to locate the intake crib opposite Whitestone Point, 63 mi. northeast of Saginaw (Fig. 2), was primarily to get well beyond the effects of pollution from the Saginaw river.

It was known that almost all of Saginaw Bay carries objectionable concentrations of chlorides from the river, while Lake Huron water at Whitestone Point is relatively free of

chlorides and has a hardness of less than 5 gr. per gal. Moreover, the intake crib could be sunk in 50 ft. of water, 2 mi. offshore, thus avoiding trouble from frazil ice often encountered with shallower depths prevailing in Saginaw Bay.

The story of each city's valiant but frustrated efforts to produce a satisfactory water are similar in pattern. For the past 75 years Saginaw has obtained its public water supply from the Saginaw river. Originally this water was safe and satisfactory but its eventual contamination from industrial and domestic wastes forced the construction of some 200 hand-operated wells for drinking water.

In 1929, Saginaw built a 25-mgd. filtration and water-softening plant, with intake located in the Saginaw river. Although this modern plant produces safe drinking water, it has never been able to remove the objectionable tastes resulting from continually increasing pollution in the river. This pollution is caused chiefly by sugar-beet processing wastes, chlorides and brine from chemical plants, and from extensive oil fields.

Beginning in 1882, Midland took its water from the Chippewa river, without treatment. About 20 years ago it constructed a 4-mgd. filtration and softening plant and moved its intake to the Tittabawasse river, a tributary of the Saginaw. Under the present program this plant will be doubled in size and a 500,000-gal. steel reservoir constructed.

The size of the new 78-mi. water pipe line project, together with the variety of construction involved, warranted its being divided into several contracts for both construction and installation of operating equipment. The largest construction contract, as shown in the accompanying table, covered installation of the 2-mi. steel intake line and the crib, at Whitestone Point.

Bolted and ballasted crib

The crib, itself, is of bolted timber construction (12x12-in. fir) octagonal in shape and measuring 60 ft. between any two parallel sides (Fig. 5). It contains 147,000 b.ft. of timber, 90 cu. yd. of concrete and 11 tons of hardware.

The crib has been fabricated at the mouth of the Saginaw river and will be towed 34 mi. to Whitestone Point, ballasted with stone and sunk in position upon a leveled area 1 ft. above the bed of the lake. Heavy stone riprap deposited to the full 10½-ft. height of crib, on all sides, and sloping 1 on 2 will anchor the crib and protect it from wave action in Lake Huron.

Both the crib and the 66-in intake line are designed for a 100-mgd. capacity at a 3-ft. per sec. flow through the intake ports. Connection between intake and crib is by a vertical, bell-mouthed section of 66-in. steel pipe making a 90-deg. bend at its junction with the 66-in. intake line and extending up into the center of the crib.

Construction of the intake line was started in June 1947 and by Nov. 15, when winter weather forced the suspension of this part of the work, all but 1,200 ft. of the 10,400-ft line had been installed.

The pipe was shipped by rail in 40-ft. lengths to Tawas, Mich., welded into 120-ft. sections, coated inside and out with a coal-tar base enamel, bulkheaded and towed 15 mi. by tug along the west shore of Lake Huron to Whitestone Point.

Excavation for the intake pipe was by a combination of power shovels, dipper dredge and clamshell dredge. The first 1,120 ft. of trench, all in rock, beginning at the pumping-plant suction well, was blasted and excavated by crawler crane and backhoe working in an earth and rock fill cofferdam built out into the lake as the work progressed.

The next 1,820 ft. of trench, also in rock, was excavated by the Great Lakes Dredge and Dock Company's 12-cu. yd. dipper dredge "Mogul", which started at a point 3,000 ft. from the suction well and worked in toward shore. The remaining 7,400 ft. of trench was excavated by a 7-cu. yd. clamshell dredge since, at 3,000 ft. from the suction well, the Mogul

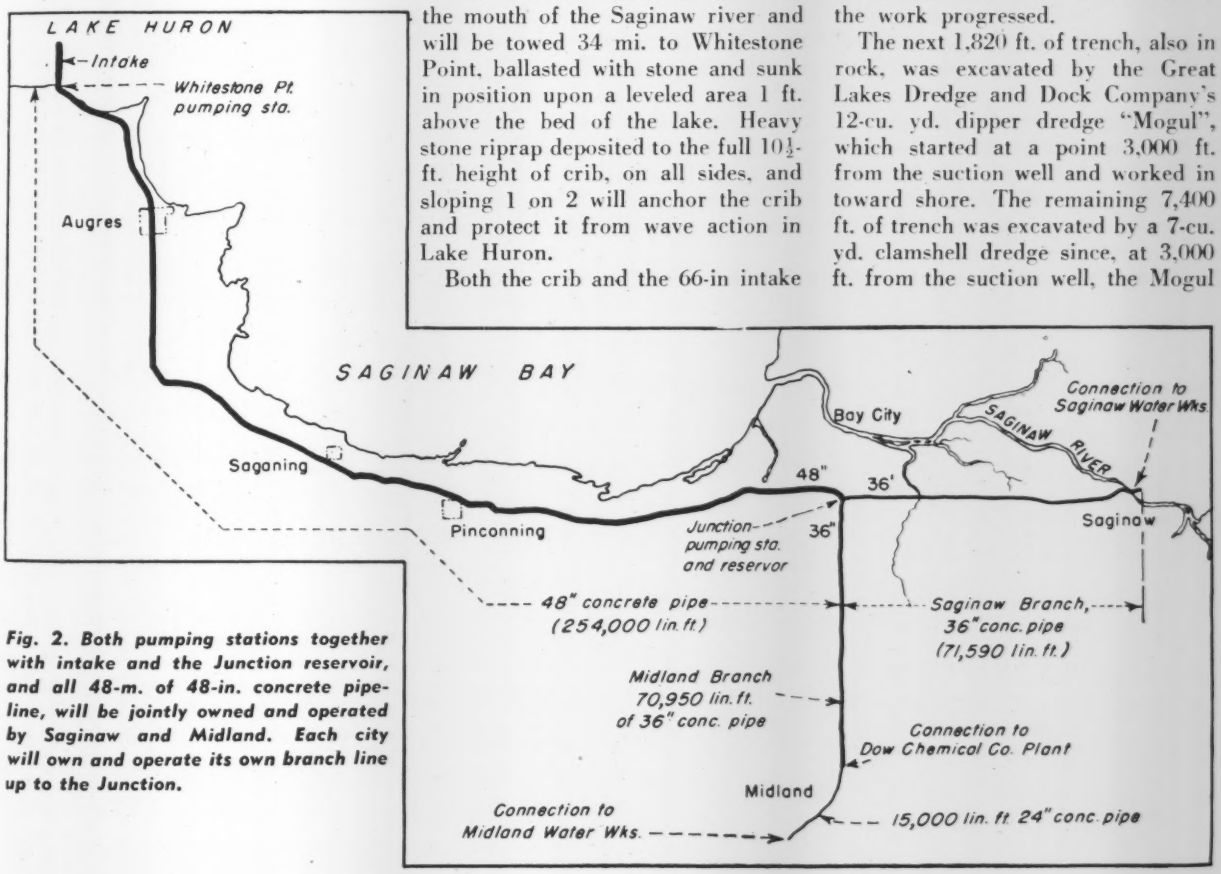


Fig. 2. Both pumping stations together with intake and the Junction reservoir, and all 48-m. of 48-in. concrete pipeline, will be jointly owned and operated by Saginaw and Midland. Each city will own and operate its own branch line up to the Junction.

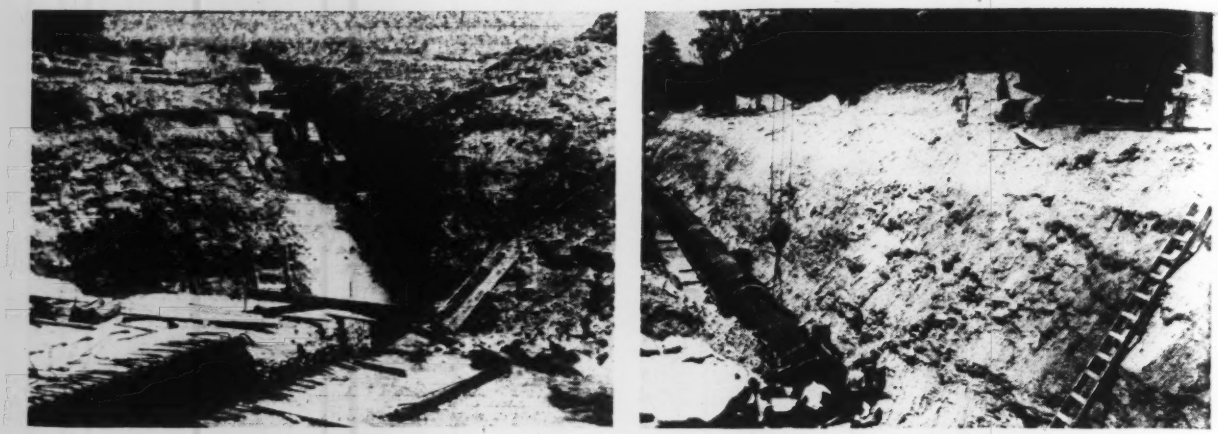


Fig. 3. By extending an earth fill and rock cofferdam out into Lake Huron, both excavation of trench (at left) and installation of the first 1,120 ft. of 66-in. steel pipe intake (at right) were performed in the so-called "dry".

had completed her assigned operation in the rock.

All the excavation and pipe laying inside the limits of the cofferdam were performed in the so-called "dry" with the aid of a battery of pumps. As the work progressed, material excavated from the trench was trucked ahead to extend the cofferdam fill. Bottom of trench inside the cofferdam was 22 ft. below lake level, with the bottom 15-ft. of excavation in rock.

To avoid possible damage from scouring action along the bottom of the lake, specifications require that the entire intake line be laid in a trench dug a minimum of 10 ft. below the bed of the lake. Moreover, the trench is required to be backfilled with excavated material and covered with 1 cu. yd. of 3-in. to 6-in. stones per lineal foot of pipe.

All underwater pipe installation was performed by divers. Joints between the 120-ft. welded sections of pipe were closed with two 36x2-in. harness bolts engaging steel castings welded to the pipe. Joints were sealed with "Dresser" couplings and rubber gaskets.

Saginaw River crossing

Water flowing in the Saginaw branch of the new line will be carried under the Saginaw river through 670 ft. of welded 36-in. steel pipe, coated inside and out with a coal-tar base enamel and wrapped with an asbestos felt.

The central 500-ft. section of this pipe was welded in one continuous length on timber skids built along the shore of a turning basin in the river. Ends of the pipe were bulkheaded. It was launched into the turning basin, 40-ft., 45-deg. risers were added at each end, by welding, and the entire assembly floated into position. A line of 36-lb. steel sheetpiling was hung temporarily along each side of the pipe for ballast and it was sunk into position in a trench excavated 10 ft. below riverbed.

Additional 45-deg. bends of 36-in. steel pipe were welded to the upper ends of the risers and extended to valve connections with the 36-in. prestressed concrete pipe on each side of the river.

By agreement made between the two cities, Saginaw will pay 23/43 of

TABLE OF CONTRACTS AND CONSTRUCTION COSTS

General Contractors:	Description	Contract Price
	Furnishing Prestressed Concrete Pipe:	
Lock Joint Pipe Co., Trenton, N. J.	254,500 lin. ft. of 48-in.	$3,744,700
Lock Joint Pipe Co., Trenton, N. J.	15,000 lin. ft. of 24-in.	89,500
Price Bros. Co., Dayton, Ohio	142,550 lin. ft. of 36-in.	1,369,100
	Installing Prestressed Concrete Pipe:	
Price Bros. Co., Dayton, Ohio	*125,600 lin. ft. of 48-in.	813,600
Chas. F. Smith & Son, Dayton, Ohio	128,900 lin. ft. of 48-in.	849,180
L. W. Wells Const. Co., Saginaw, Mich.	71,590 lin. ft. of 36-in.	414,140
Bass Engineering & Const. Co. and Thomas D. Nolan, Birmingham, Mich.	70,950 lin. ft. of 36-in.	421,550
	15,000 lin. ft. of 24-in.	86,300
	Other Contracts:	
Great Lakes Dredge & Dock Co., Cleveland	Lake Huron intake & crib	1,243,200
M. J. Meagher & Sons, Bay City, Mich.	Saginaw river crossing	79,030
Bass Engineering & Const. Co.	Pumping sta. & reservoir	798,800
DeLaval Steam Turbine Co.	Pumps and motors	123,000
S. Morgan Smith Co.	Valves	99,060
Chapman Valve Mfg. Co.	Valves	58,740
Filer & Stowell	Valves	3,830
American Cast Iron Pipe Co.	Pipe, Fittings (Pumping sta.)	50,220
General Electric Co.	Switch gears	28,870
Simplex Valve & Meter Co.	Venturi meters	13,520
Wallace & Tiernan Co.	Chlorinators	12,760
	TOTAL CONTRACT COST.....	$10,299,100

* Includes 43,000 lin. ft. subcontracted to Johnson Green Co. and Walter Toebe Co., Ann Arbor, Mich.

all costs incurred in the design and construction of the Junction pumping station and reservoir, the 43-mi. of 48-in. line, the Whitestone Point pumping station, the intake line and crib.

Midland will pay the remaining 20/43 of these costs. This division of costs for the jointly-owned line and appurtenances is based on current pumpage of the two cities. Saginaw has an average consumption of 11.5 mgd., while Midland's average consumption of 3 mgd. together with the 7 mgd. to be sold to the Dow Chemical Co. totals 10 mgd.

Operation of both pumping stations and the 48-in. pipeline will be under the supervision of a six-man Board of Water Commissioners of the Saginaw-Midland Water Supply System, composed of three men from each city.

Each city will pay all costs of constructing its branch line from filtration plant to the Junction pumping plant and, upon completion of the project, will assume the responsibility of their respective operations.

Funds covering the entire cost of the project—which is estimated to total $12,000,000 including overhead, interest during construction, engineering, incidentals, etc.—were secured through the sale of revenue bonds. Saginaw, which had accumulated $1,275,000, sold $4,800,000 worth of bonds. Midland's bond issue was for $6,000,000.

Bonds will be retired through increased service charges, to become effective Sept. 1, 1948. Midland's water rates will be increased a flat 33 percent, while the "readiness-to-serve" charge only for Saginaw will be increased equivalent to $4 per year for the average household user. In addition, the Dow Chemical has agreed to buy a minimum of 7 mgd. from Midland.

Rural service provided

Service also will be furnished 8 villages and over 1,200 individual farms, households and other small users located near the pipeline right-of-way. To furnish this service, provisions were made for tapping the concrete pipe as it was laid. Holes of varying sizes from 1 in. to 12 in. dia. were cast in the pipe at the casting plants.

Primary chlorination will be added at the Whitestone Point pumping plant but no other treatment will be given the water until it reaches the filtration plants at Saginaw and Midland.

In addition to the Saginaw river crossing, the new pipeline will involve nine minor stream crossings, all beneath the streambeds. Hand-operated gate valves were installed in the concrete pipe at 3-mi. intervals, with an inspection manhole located about midway between every two valves. Automatic air-release valves are located at all high points in the line and gate valves at each low point will facilitate drainage, inspection and repair of the pipe.

Engineers and contractors

Alfred Eckert, manager of the Saginaw-Midland Water Supply System, represents the two cities in overall supervision on construction of the entire project. Eric F. Wieneke is chairman of the Saginaw-Midland joint board of water commissioners.

Alvord, Burdick and Howson, consulting engineers, Chicago, prepared the surveys, plans and specifications and are supervising construction. V. R. Kneer is project engineer, assisted by a crew of 14 inspectors. Preliminary surveys for the water line were prepared under the supervision of the late Henry A. Nunlist, consulting engineer, Cincinnati Ohio.

Construction superintendents for the Great Lakes Dredge and Dock Co., contractors for the 2-mi. steel intake pipe and crib, include: E. H. Hansen, E. E. Lewitz, and J. F. Cunningham. Ray Durocher was superintendent for W. J. Meagher and Sons, on construction of the Saginaw river crossing.

Methods and equipment employed in the manufacture and installation of the 78 mi. of prestressed concrete pipe will be detailed in a forthcoming issue.

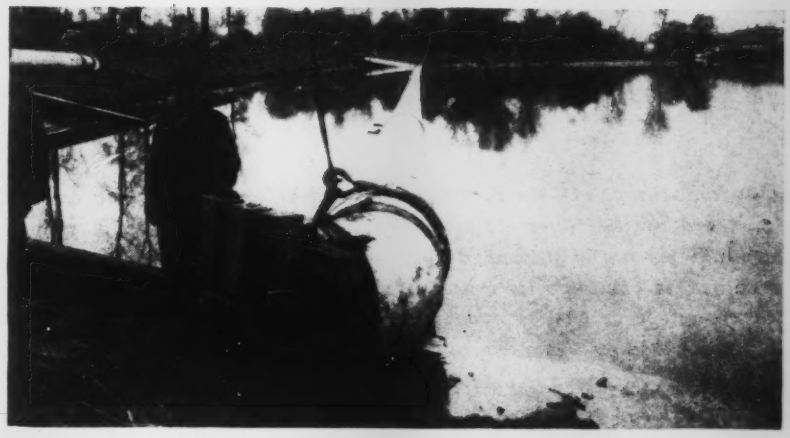


Fig. 4. Coated steel pipe was welded into a 500-ft. length, bulkhead, towed and sunk into position to carry the 36-in. line under the Saginaw river

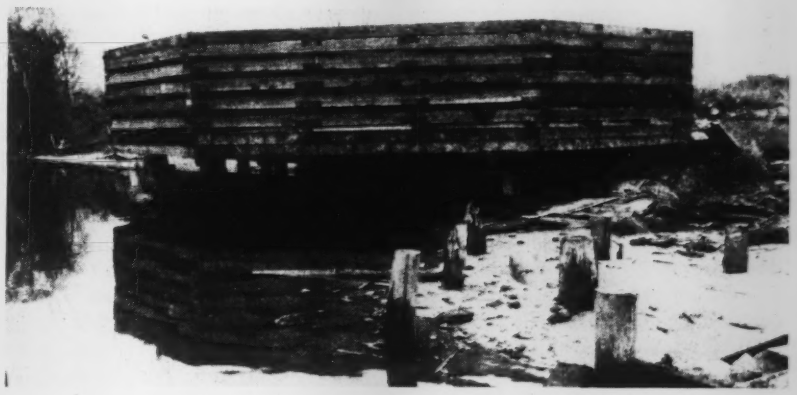


Fig. 5. The timber crib will be launched by removing the forward row of supporting piling, and towed 34 mi. to Whitestone Point.

Filtering Water Continuously

Contents in Brief—An automatically washed rapid filter with an 11-in. sand bed at the Newton Falls Paper Co., Newton Falls, N. Y., removes about 99 percent of suspended solids with no pretreatment other than chlorination. In operation for over two years, this plant, which produces water for manufacture of highgrade paper as well as domestic consumption in Newton Falls, requires a minimum of supervision. In addition, treated water is delivered continuously without shut downs for washing.

CONSUMING not more than 3 kwh. of electricity per day and less than 0.5 percent of the output in wash water, an automatically washed rapid-sand filter at the Newton Falls Paper Co. has operated for over two years without a shutdown. The filter delivers water at rates varying from 500 to 3,200 gpm., and the daily output is as high as 3½ mg., depending on mill requirements. The water is used for manufacture of high-grade book and magazine paper as well as for domestic use in Newton Falls, N. Y.

With no pretreatment except chlorination, it is said the filter removes more than 99 percent of suspended solids in raw water drawn from the Osemegatchie River—a typical Adirondack-region supply containing considerable amounts of silt and finely divided organic matter.

Another reported advantage is that minimum supervision is required.

The automatically backwash filter unit is in a reinforced concrete structure, 4.33 ft. deep covering a total area of 2,061 sq. ft. (Fig. 2). Dividing walls set off an influent chamber with a superimposed wash-water receiving channel, filter bed, an effluent channel and a collecting passage to convey filtered water to the clear well.

The influent chamber, 3.33 ft. deep and 1.5 ft. wide, extends along one side of the unit. A series of 1½- x 8-in. slotted ports located near the top of the chamber permit entrance of raw water to the filter bed. Located above the influent chamber is the wash-water receiving channel, which is 8-in. deep and 18-in. wide.

The filter proper is 12.5 ft. wide and 90 ft. long to provide an area of 1,125 sq. ft. It is divided into 120 transverse sections as shown in Fig. 2. The 9-in. wide sections are formed by vertical steel plates between which one-inch porous carborundum plates are fixed horizontally, 10-in. above the floor, by small angle irons. The plates carry an 11-in. bed of filter sand above the 9-in. wide underdrainage channels.

The filter bed is composed of sand with the following depths and grain diameters:

3.6 in. of 0.83 to 1.17 mm. (14 to 20 mesh)
5.3 in. of 0.36 to 0.83 mm. (20 to 40 mesh)
2.1 in. of sand smaller than 0.36 mm.

Below the plates, each transverse section is connected to a corresponding cell in the effluent channel by a 3½-in. pipe through a common concrete wall. This combination of filter and effluent cells provide 120 separate units of 9⅜-sq. ft. area. These units permit individual washing of each transverse section without downflow interference in adjoining sections.

The 2-ft. wide effluent channel extends along one side of the filter opposite the influent chamber. On the bottom of the channel cells made of cypress woodwork are located to correspond to the filter sections. Each cell opens into the effluent channel through the top of the woodwork in slotted hole, 5½-in. long and 3½-in. wide with semi-circular ends. The top of the outside wall of the effluent channel is divided into six-inch overflow weirs which alternate with six-inch non-overflow sections.

The weirs open into the collecting passage adjacent and parallel to the effluent channel. This passage, which is 1.67 ft. wide and 3.0 deep, connects with the clear well. A wood walkway is located above the passage.

Raw water introduced at one end flows along the influent channel, through the slotted ports onto the filter bed, and downward through the 11-in. sand bed into the collecting channels. Filtered water then passes across the filter to the effluent channel, over the 6-in. outlet weirs, and through the collecting passage to the clear well.

The filter is designed to operate at rates up to 3 gpm. per sq. ft. of filter area. The rate is determined by

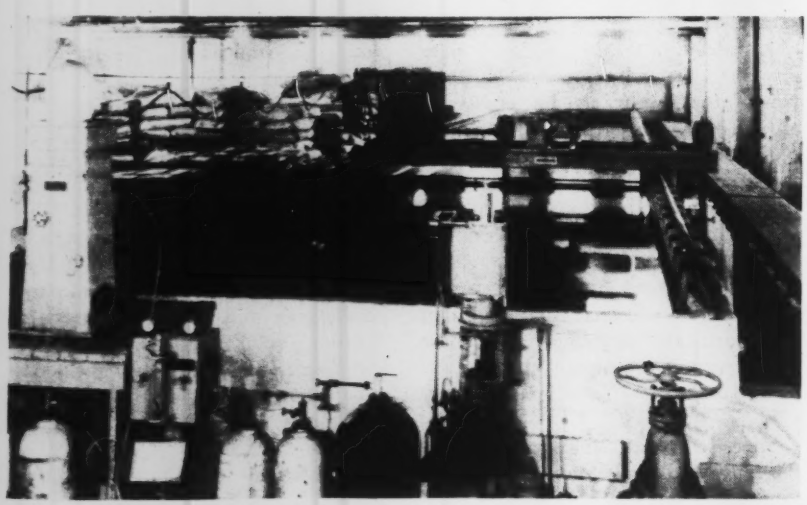


Fig. 1. At the Newton Falls (N. Y.) plant, chlorine is fed to the raw water entering the filter. Overflow weirs to the collecting passage, which is covered with a wood walkway, are shown at the right.

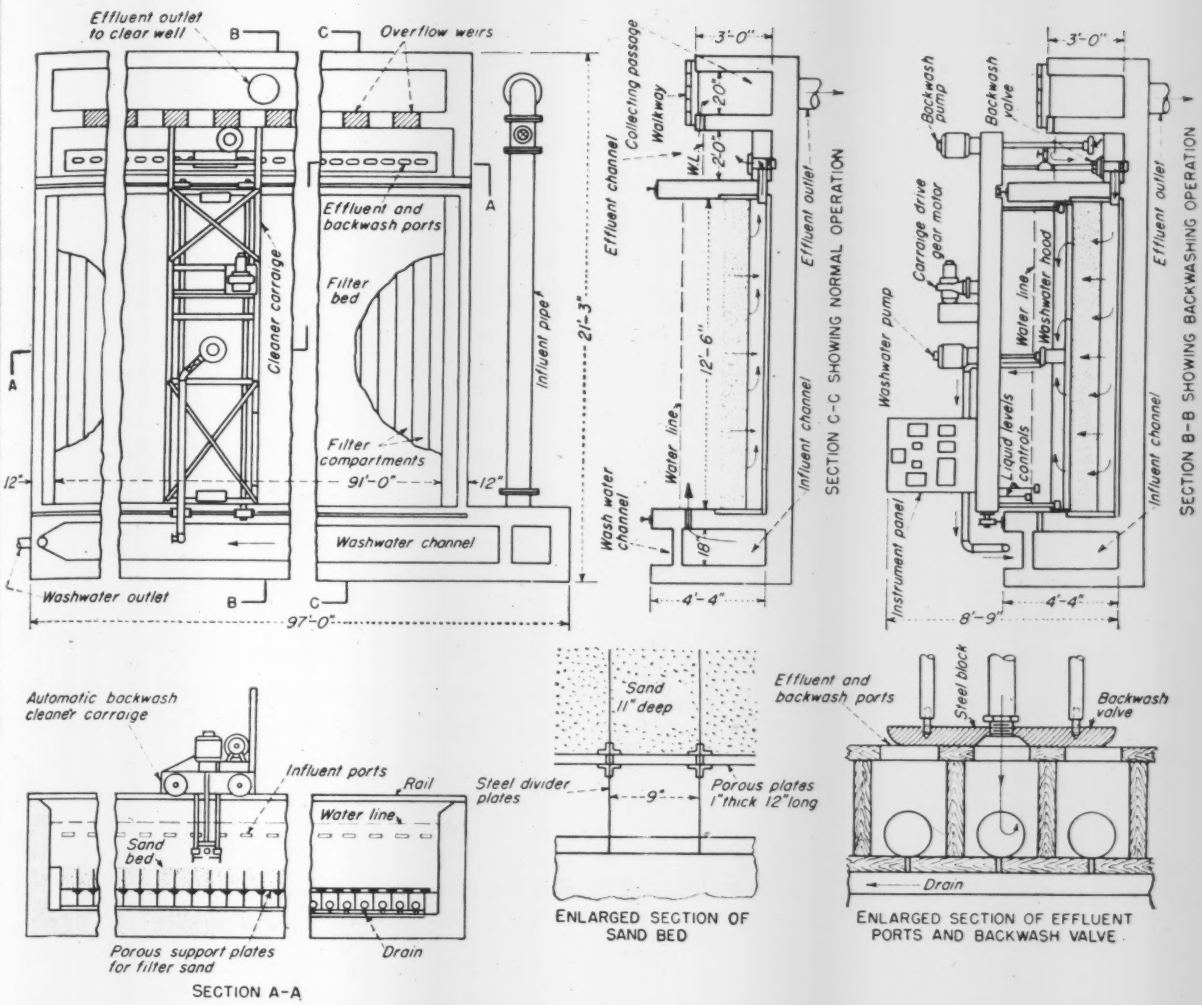


Fig. 2. The automatically washed filter consists of an influent channel, a sectionalized sand bed, effluent and outflow channels and a traveling cleaner. The cleaner is made up of two centrifugal pumps, a special back-wash valve and a wash-water collecting hood extending across the filter and suspended just above the sand surface.

the clear-well water level, controlled by an automatically actuated valve, and measured by propeller-type meter.

Filter cleaned by twin pumps

The cleaning mechanism is carried on an electric-motor-driven carriage that spans the filter and rolls on rails set on the top of the sidewalls. This traveling bridge supports two 1½-in. electrically powered centrifugal pumps, liquid-level controls, an instrument panel, a backwash valve and a wash-water collecting hood.

One pump forces filtered water from the effluent channel through the backwash valve, into a filter section and upward through the sand. The other pump draws off roiled water through the 12-inch. wide by 8-in. high collecting hood. The hood extends across the filter under the carriage and is suspended just above the sand surface.

The backwash valve made of a heavy steel casting with a 5½ x 3½-in. central opening rests on and slides over the cypress wood frame that forms the cells in the effluent channel (Fig. 2). The valve is designed to increase and decrease wash-water flow gradually as its opening passes over the cell port. After backwashing, the cell is sealed by the sliding plate to permit settlement of sand in the filter compartment. As the plate moves off the cell port, filtration is resumed. No sand is lost in washing.

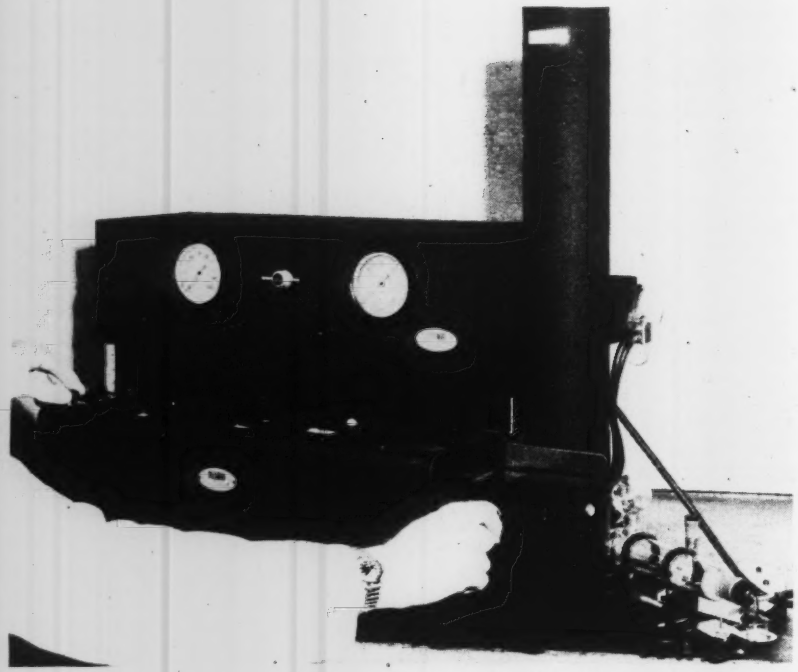
Actuated by water-level controls and the instrument panel, the carriage and pumps start to operate when the water over the filter is about seven inches above the effluent-channel level. They stop the unit when the head drops to six inches.

When operating, the carriage moves at the rate of 4 fpm. At the end of the filter, the carriage reverses its direction of travel.

Wash water is delivered at the rate of 12 to 13 gpm. per sq. ft. At a carriage travel of 4 fpm., 22 gal. of water is pumped into each cell during a 11-sec. washing period. This is at a rate of 2¾ gal. per sq. ft. of cell area.

Bacterial counts are reported as follows: Total—input about 62 per milliliter; output, 9 per ml. Coliform group—input about 38 per ml., output, less than 2.2 per ml.

R. W. Haynes is president of the Newton Falls Paper Mill and R. O. Osborn is chief engineer. The automatically washed filter was manufactured and installed by Hardinge, Inc.



Flame Spectrophotometer, which is designed to make mineral analysis of water samples quickly and with only a small quantity of water.

Flame Spectrophotometer Determines Mineral Content in Water Rapidly

Of aid in analysis of mineral content of water is a recently announced instrument that will determine by spectrophotometric methods the nature and amount of metal elements present in water. In the waterworks field, the Beckman Flame Spectrophotometer is believed to have best application in large private and municipal water laboratories, particularly with zeolite softening.

The instrument atomizes water samples and feeds them into a hot oxygen flame. The hot-flame treatment adapts the samples to spectral analysis by a standard quartz spectrophotometer, an instrument that isolates the spectral lines and measures their intensities. Advantages attributed to the instrument include swiftness of results and small quantity of sample required.

Among the many elements that can be analyzed are calcium and magnesium, the two elements of major concern in connection with water-hardness determinations. Amounts of these and other minerals present can be quantitatively determined to an accuracy of 0.1-0.2 percent. Samples can be placed and analysis for a single element made at the rate of four per minute.

Chemical analysis is time-consuming

Conventional quantitative analyses for calcium, such as the gravimetric oxalate method, require considerable time and attention. In many cases other chemical compounds have to be removed preliminary to performing the analysis. Such methods are not required when using the flame spectrophotometer.

In analyses for magnesium, the instrument's maximum sensitivity is about 5 ppm. Thus, with water of low magnesium content, some concentration of the samples is necessary before measurements of a high order of accuracy can be taken. However, for most water-supply purposes, if magnesium is present in quantities less than 5 ppm., it can usually be ignored.

Sodium and potassium are two other elements which can be determined with ease, whereas ordinary analytical methods are detailed and involved. Thus, the instrument is believed to be quite useful in connection with softening processes using sodium zeolites or synthetic resins.

Ratings of intensity as measured by the instrument can be converted by simple computations to parts per million of the element present. Determinations are said to be simple and rapid, and checks or complete re-analysis require less than a minute.

The Flame Spectrophotometer is manufactured by the National Technical Laboratories, South Pasadena, Calif., and is essentially an attachment to the Beckman Model DU Quartz Spectrophotometer which has been available for some time.

Railroad Blast Plates Of Low-alloy Steel

During the past 8 to 10 years a number of blast plates made of low-alloy, high-tensile steel have been installed on railroad overpasses to protect the steelwork in the bridge structures from the corrosive effect of the hot, sulphurous fumes and the abrasive action of the dust and cinders in the locomotive smoke. Recently Bethlehem Steel Co. made a survey of seventeen blast plate installations in eleven different states, in which the company's Mayari R steel has been used. Practically every type of climate is encountered in one or another of the localities involved. The oldest of the installations dates back to 1939.

The original thickness of the plates used in the various installations ranged from $\frac{1}{2}$ in. to $\frac{5}{8}$ in., and the height above the track from 15 ft to 23 ft. In no case does the observed corrosion of the section exceed $\frac{1}{16}$ in., and in most instances the plates are reported to be in excellent condition, with very little evidence of corrosion, pitting, or wear, and with the reduction in section too slight to be measured. Even in the cases of low clearance above the track, the records are reported to be highly satisfactory.

Mayari R steel has an ultimate tensile strength of 70,000 psi min., a yield point of 50,000 psi min., and a resistance to atmospheric corrosion five to six times that of mild carbon steel.

Liquid Carbon-Dioxide Recarbonation Permits High Absorption Rates

Harry Stock
Engineer, Water Softening Plant
Minneapolis, Minn.

Contents in Brief—Costing about one-third that of a conventional recarbonation plant, a liquid carbon-dioxide installation has been erected at the Minneapolis, Minn. water-softening plant. The installation consists of two rotary pumps, two 40-ton storage tanks, two vaporizers, two refrigerating units, a control panel and headers and porous hose diffusers. As the water absorbs about 98 percent of the gas, an expensive exhaust system is not required to protect the health of plant operators.

A LIQUID carbon-dioxide recarbonation installation which achieves about 98 percent of absorption in the water has been built in the Minneapolis, Minn. water-softening plant. This performance is in contrast with 12-15 percent absorption attained by conventional flue-gas or carbon-dioxide producing systems.

Designed on the basis of operating results obtained from a simple experimental unit, recarbonation installation is employed to neutralize caustic alkalinity resulting from softening and to control pH.

The experimental unit mounted on a six-ft. square control board was developed by the Cardox Corp. of Chicago who were employed to work out a method of applying liquid carbon dioxide to water. Two vaporizers and one vapor heater were mounted on the back of the control board. Two rotameters to measure carbon-dioxide flow and various automatic instruments, such as temperature and pressure controls and valves to permit flexible operation, were supported on the front of the panel.

The experimental plant was operated directly from a tank car of carbon dioxide under a pressure of 250 to 300 psi. From the car a liquid and a vapor line were run to the board. In normal operation the liquid was passed through electrically heated vaporizers to thermostatically controlled vapor heaters. A pressure reducing valve was employed after the vapor heaters to overcome water back-pressure. At reduced pressure the vapor was passed through rotameters and into the diffusers for discharge into the water.

From the knowledge gained by the operation of the experimental board, a permanent plant, which has been in operation for about six months, was designed.

Permanent recarbonation plant

The permanent recarbonation plant consists of two small rotary pumps powered by 3 hp. motors; two 40-ton storage tanks; two vaporizers equipped with electric heaters; two refrigerating units; a control board; and headers and diffusers from which carbon-dioxide gas is discharged into the water.

Carbon dioxide is received in tank cars of about 24-ton capacity. In the tank-car dome two outlet pipes are located. One serves as a vapor line extending into the top of the car tank and the other as a liquid line extending into the tank bottom.

During plant operation carbon dioxide is transferred from the car to storage tanks by pumps. The pump suction is attached by a hose to the liquid line in the car dome. Another hose is connected to the vapor line also in the car dome. The second hose runs to a permanent vapor line which extends into the top of each storage tank. This is a equalizing line between the car and storage tank.

The pumps deliver liquid to the bottom of storage tanks. They are connected so that each pump can deliver into either tank and also from one tank to the other. This flexibility is possible because the pumps are reversible. Either side of a pump can be utilized for suction or discharge as service demands. All high-pressure piping is insulated with 1½ in. of cork.

Storage tanks hold 40 tons

The storage tanks are 6.5 ft. in diameter and about 42 ft. long with a capacity of 40-ton. Each tank is equipped with a tape gage that indicates in inches the depth of carbon dioxide. Readings are converted to pounds of carbon dioxide from a table of depths and weights. The working pressure maintained in the tanks varies from 270 to 300 psi. at a carbon dioxide temperature of about zero deg. F.

To prevent condensation on the outside as well as uncontrolled vaporization, the tanks are covered completely with 6 in. of cork insulation. The cork is wrapped with an asphalt-treated cloth and surfaced with aluminum paint.

The tanks are equipped with three safety features—two blow-off valves and a lead diaphragm. One safety valve opens at 345 psi. the other at 357 psi. The lead diaphragm, which seals the 4 in. vent pipe passing through the roof, breaks at 640 psi. As an additional safeguard to minimize pressure when a tank is out of service, each tank is connected to a refrigerating unit which automatically cuts in when the pressure increases to 325 psi. These units cool the carbon dioxide and inhibit vaporization which maintains low tank pressure.

During operation of the plant

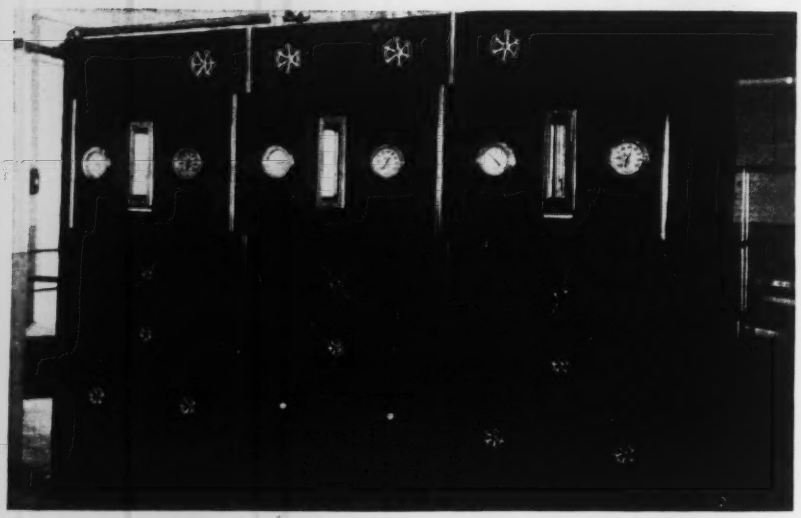


Fig. 1. A single control panel contains three rotameters, temperature and pressure controls and regulating valves.

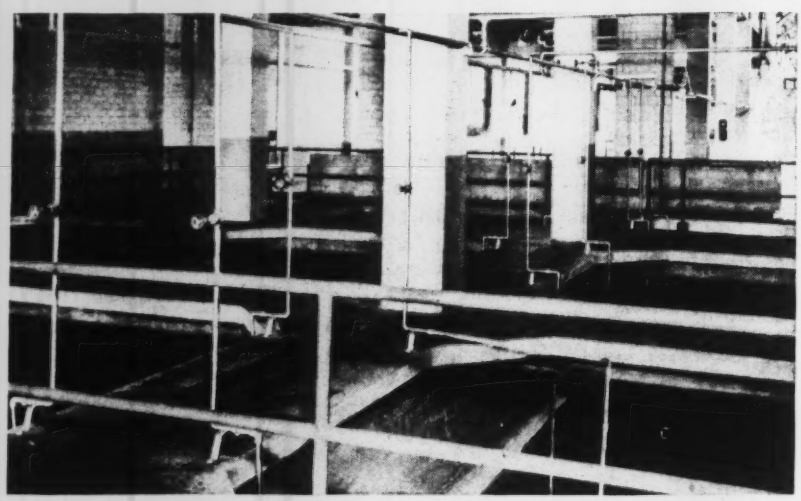


Fig. 2. Two 40-ton storage tanks provide continuity of service. Refrigerators (in the foreground) maintain low tank pressures when the units are out of service.

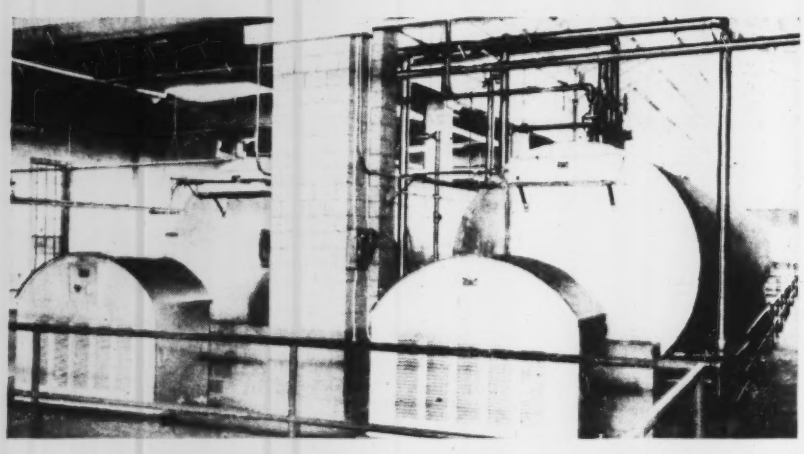


Fig. 3. Two headers, which are interconnected to provide flexible operation, run from the control panel to valved risers that feed porous hose diffusers in the bottom of recarbonation chambers.

liquid carbon dioxide passes from the bottom of tank cars to a vaporizer on the side of each tank. The vaporizer is contained in a receptacle equipped with a thermostatically controlled heating element and a pressure switch. Application of heat to the liquid carbon dioxide converts it to a vapor at a pressure of about 270 psi.

From the vaporizers the gas passes into the top of storage tanks and thence to the control board. The liquid line is not connected with the board.

All instruments needed to introduce the gas into water at a reduced pressure and in an amount called for by the chemical treatment are mounted on the control board. On the back of the board are two vapor heaters—small tubular receptacles through which the gas passes and is heated to 50 deg. (the temperature for which the rotameters are calibrated). Vapor heaters are fitted with piping so that either or both can be used with each meter.

Three meters are provided

The control panel contains three rotameters. Two meters have a capacity of 400 lb. per hr. each and one has a rating of 650 lb. per hr.: or a total output of 1,450 lb. per hr. This capacity is in excess of the present needs but the meters can be used singly or in any combination to operate within an efficient range for a great variation in the water demand. Total capacity of the control board is sufficient to take care of the future needs of the city indefinitely.

Gas enters the control board at a pressure of 270 psi. Before passing through the meter its pressure is reduced to 20 psi. by a valve. The meters are set at an hourly rate to satisfy chemical demands needed to reduce phenolphthalein alkalinity to the desired pH zone. The water enters recarbonation chambers with a pH value between 10.2 and 10.5 and is reduced to 9.5 by the carbon-dioxide treatment.

From the meters two vapor lines are connected with two pipe headers that serve the diffusers. Headers are cross-connected so that either line from the meters can supply gas to either header. The headers extend beyond the existing diffusers, thus providing for rapid installation of additional diffusers, if necessary.

Each header, 25 ft long, serves six

diffusers. Each diffuser is fed from a header by a ¾-in. pipe extending to within a few inches of the bottom of the recarbonation chamber and terminating in a ¾x1½-in. elbow. A 1¼-in. nipple about 3-in. long is screwed into the elbow. The diffuser hose is clamped over the nipple.

Gas dispersed through hose walls

Diffusers consist of a length of 1½-in. unlined, water-resistant hose. Carbon-dioxide gas is distributed in minute bubbles uniformly through the hose wall.

Inside the diffuser a ½-in. pipe is used to keep the hose extended. The pipe is unconnected near the riser elbow but is clamped to the far end of the hose on a 1¼-in. nipple.

The far end of the diffuser is hung from a ½-in. vertical pipe attached to the pipe rail on the floor above.

Aside from the manually operated valves for unloading tank cars, the plant is completely automatic. Pressure in storage tanks is kept nearly constant by the automatically controlled vaporizers and refrigerating units when out of service. Vapor pressure at the control board is maintained constant by the pressure-reducing valve. A temperature of 50 deg. F. is maintained by automatically controlled vapor heaters.

The diffusers are unique in that each is a separate unit and the entire layout bears no resemblance to the orthodox grid. To repair or replace a diffuser, a union is unscrewed and the diffuser hose raised. A new hose is slipped on the frame and the diffuser dropped into place. Replacement requires no more than 20 or 30 min. and does not in any way interfere with the recarbonation process.

The minute pores of the hose diffusers are ideal in size and do not clog or corrode. Passage of carbon-dioxide gas through these pores results in a very good distribution of the gas throughout the water.

Liquid carbon-dioxide used in the plant is nearly 100 percent pure. Due to this fact and fine diffusion of the gas, the absorption coefficient is almost 98 percent.

The high absorption coefficient brings up an interesting point in the design of recarbonation chambers contemplating using low-pressure, pure, liquid carbon-dioxide. When flue gas or carbon dioxide produced by burning is used, the absorption can at best be 12 or 15 percent as the gas so produced contains from 85 to 87 percent inert gases. Such absorption would mean that the area of distribution of the carbon dioxide would have to be about seven times that required for pure carbon dioxide. It is readily seen how this factor would be reflected in the structural cost of the plant.

In plants using flue gases, about 87 percent of inert gases is not absorbed by the water and escapes into the room. These gases are injurious to health and must be disposed of. In the Minneapolis plant, which treats up to 120 mgd., escaping gas would be a serious problem. To dispose of such gases would have required an elaborate exhaust system or a chamber cover to confine the gases and vent them through the roof.

The main consideration for the Minneapolis installation was avoidance of serious corrosion encountered in the orthodox type of plant. In this plant corrosion is not a maintenance problem.

Cost reduced about 65 percent

A standard plant using flue gas would cost on prewar basis about $90,000. To this sum would have to be added the expense of an exhaust and ventilating system. The liquid carbon-dioxide plant was built for about a third of the total cost of a conventional plant.

At present the cost of pure carbon dioxide for recarbonation in water softening, exceeds that of carbon dioxide obtained from gases produced by burning. It is felt, however, that use of the pure product is another step forward in the application of carbon dioxide for stabilization of softened water and pH control. As far as cost is concerned, a great saving in water softening has been brought about by the use of low-pressure liquid carbon dioxide in place of filter alum for acidification.

Another fact which was not overlooked was that the use of pure carbon dioxide would open up a new market for those producing carbon dioxide and that competition would soon effect a reduction on price. There is concrete evidence of the favorable influence of competition at this writing.

The permanent plant was designed by the engineers of the Cardox Corp., Chicago, Ill. and the author. Mr. A. W. Wahlgren represented the Cardox Corp. during the development of this installation.

Polyethylene Sheathing Developed For Extra High Voltage Cables

Extra high-voltage cables are now being sheathed with polyethylene instead of the conventional lead. Already extensive installations are under construction in New York, Florida and Wisconsin—two at 138,000 volts.

These installations, called compression cable systems, consist of three oil-paper insulated conductors, each of oval cross section and protected over all by a metal-reinforced polyethylene sheath, pulled into a steel pipe line laid beneath the streets. The pipe is filled with gas or oil at 200-lb. pressure.

Basically, high-voltage cable installation requires that the conductor be surrounded by a dielectric or nonconductor capable of resisting normal or average heat, plus the abnormality or extreme heat caused by emergency load. The most common dielectric is a chemically inert oil. To maintain the oil in uniform proximity with the conductor, it is applied as an impregnation of a cellulose paper wrapped mechanically tight to the high-voltage cable.

The final basic problem is to inclose the conductor and its dielectric in a casing which protects it from moisture and contamination, and maintains its mechanical and electrical integrity. The polyethylene sheath fulfills these requirements, making the cable a factory-sealed unit throughout shipment, installation, and service life.

The cable is said to be capable of carrying four times its normal working voltages and to satisfy fully the need for a cable whose life should be 30 to 50 years at a minimum.

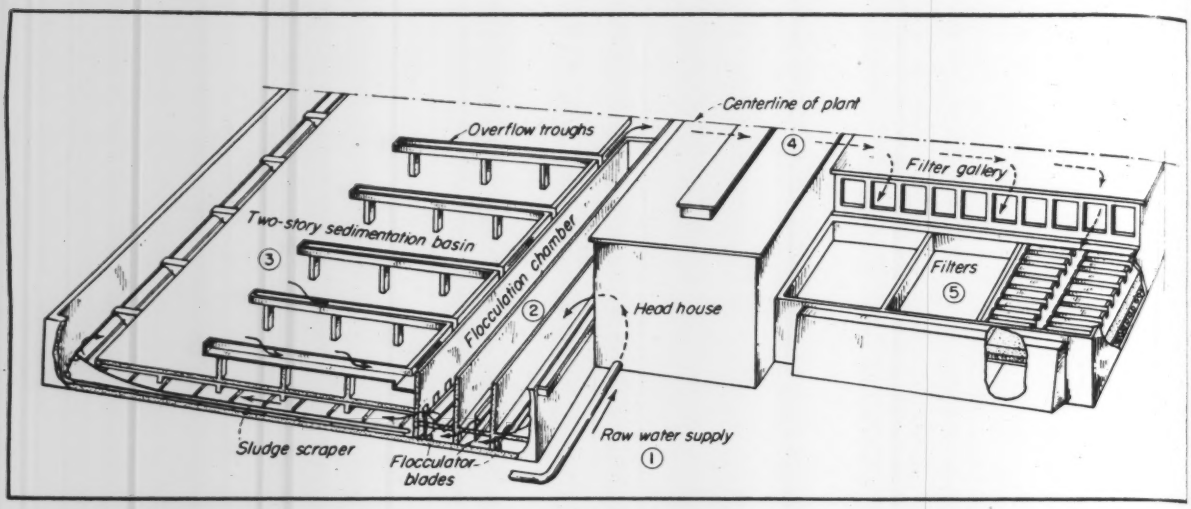


Fig. 1. Chlorinated and aerated water (1) enters the flocculation chamber (2), passes through three rows of mixers and into the two-story sedimentation basin (3). Activated carbon is then added (4) and the water is filtered (5).

Two-Story Sedimentation Basin Features Filter Plant Layout

Linne C. Larson
Partner, Taylor & Taylor, Engineers,
Los Angeles, Calif.

Contents in Brief—Design feature of a water treatment plant for Long Beach, Calif., is arrangement of two-story sedimentation basin that follows the flocculation process. The 25-mgd. plant is designed to remove odor, color and taste from an unusually soft water supply.

A UNIQUE ARRANGEMENT of two-story sedimentation basins following flocculation is incorporated in the design of the Long Beach, Calif., water treatment plant scheduled for construction this year. Advantage of the two-story arrangement is that continuous sludge-removal equipment need be provided for only the bottom portion where sludge accumulation is greater. Two basins of equal size are provided so each in turn can be periodically taken out of service for cleaning.

This 25-mgd. plant will remove odor, color and taste from well water without changing such desirable characteristics as unusual softness (averages 40 to 50 ppm.). Effluent will be mixed in a 43-mg. reservoir with filtered and softened Colorado River water supplied the city by the Metropolitan Water District of Southern California. This water, originally very hard, will have been softened by the district to some 100 ppm. Thus the good qualities of each water supply will be combined. Average daily consumption in Long Beach is 30 mgd.

Mixers in three rows

Just before reaching the flocculation basins, chlorinated and aerated water is dosed with 12 to 20 ppm. of ferric chloride in solution. Each of these two basins is 32 ft. 4 in. wide and 107 ft. 9 in. long and contains three rows of 8-ft. dia. paddle-type mixers. Each row of mixers is separated by a concrete wall and openings through the walls at the floor line allow the water to flow through at a velocity of 0.2 fps. Average depth of water in this basin is 15 ft 10 in. Each row of mixers is chain driven by a 2-hp. electric motor.

The third row of mixers is separated from the adjoining sedimentation basin by an 8-ft. wooden weir wall. Flow is over this weir and into the 110-ft. 8-in. by 112-ft., two-story sedimentation basins. Water enters on the lower deck, flows the length of the basin and returns on the upper level, 7-ft. 5-in. above the basin floor. These sedimentation basins are to be wider than the usual design as the dimensions used are the most economical for the required detention time, 2½ hr.

Sludge scrapers on lower floor

Each of the two sedimentation basins contains six continuous scrapers (operating on the lower floor only), which accumulate the sludge and carry it to a trough at the end of the basin. Sludge in this trough is then

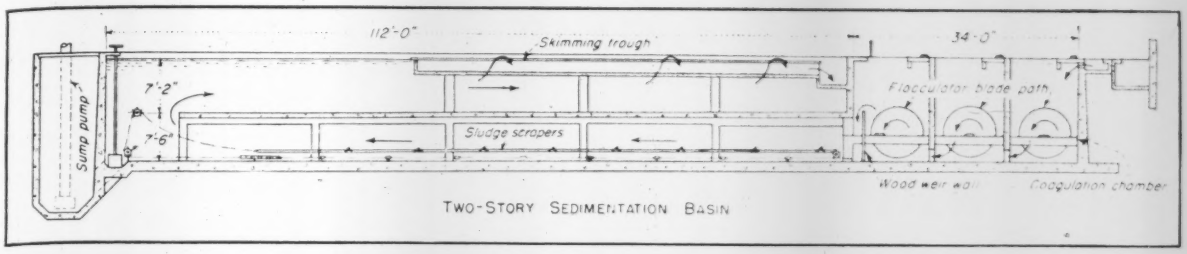


Fig. 2. Retention time in the coagulation basin is 38 min. and in the two-story, continuous sludge-collecting sedimentation basins is 2½ hr. Slow overflow rate is obtained in the settling tanks by multiple-skimming troughs.

taken to a sump by cross-collector scrapers. A sludge pump removes the sludge from the sump and it is disposed of in a storm drain.

Blades of the scrapers consist of 2x4-in. redwood connected by means of link-type chains. The 17-ft. wide mechanism travels at the rate of 2 fpm. and the return path of the blades is about 19-in. from the floor. Steel angles of 3-in. size guide the return of the scrapers.

No sludge-collection facilities are provided on the upper deck of the two-story basins as the greater percentage by weight of the floc will settle in the lower portion. The upper portion will collect fine particles and these will accumulate at a relatively slow rate. Such sludge as does accumulate on the upper deck will be removed during periodic shutdowns of one of the two basins for cleaning.

Thus these two-story basins have the advantage of mechanical cleaning, which reduces the frequency of shutdown for cleaning. Yet, the cleaning mechanism is provided for only the half of the basin where the load is the greatest.

Overflow to multiple troughs

Multiple-skimming troughs hold the water height in the sedimentation basins to 15 ft. 6 in. and permit a very slow overflow rate. Time of retention in the sedimentation basin under normal operation is 2½ hr.

The water from the sedimentation basin flows by flume to a battery of six 4.2-mgd. rapid sand-filter units. Before entering the filters, powdered activated carbon will be applied for final "polishing." Quantity of activated carbon to be used will be determined by operating experience.

Filter wash is provided both through underdrain up-flow and surface sand wash. Back-flow washwater is provided at the rate of 17 gpm. per sq. ft. of filter bed and pressure is developed by pumps taking suction from the clear water supply conduit. Surface sand wash at 4 gpm. per sq. ft. comes from the city pressure system.

Washwater ladened with backwashed activated carbon drops to two reclamation basins under each set of three filters and is 90 percent recovered after settling. Recovered washwater is mixed with the plant influent by pumping to the pump sump. Sediment is drained off and occasionally hosed out to waste.

12-hr. sunlight exposure

Flow of all supply wells is metered and first enters the plant through a 12-mg. raw-water storage basin. After the water passes over an aerating weir for gas and odor liberation, chlorine at some 30 ppm. is applied in a 3-min. dose chamber. Raw water remains in this storage basin 12 hr. when the basin is full. Baffles tend to develop chlorine contact for the full retention period of the raw-water storage basin. After leaving the storage basin, the water is pumped to the head house where the coagulant is added.

Brennan S. Thomas is general manager and chief engineer of the Long Beach Water Department and Burt Harmon is assistant general manager. Design of the new plant was prepared by James M. Montgomery, consulting engineer, and the firm of Taylor & Taylor, consulting engineers, Los Angeles, Calif.

Use of Parking Meters Is Increasing

The number of U. S. cities using parking meters has trebled since the war and now totals more than 1,500.

Information cited by the International City Managers' Association reveals that at least 300 cities have installed parking meters in the past six months.

Only 473 cities were using parking meters at the start of 1946 according to data collected by Vehicular Parking, Ltd. Meters to regulate parking are most popular in cities of the 100,000 to 500,000 population bracket.

Three-fourths of the cities from 100,000 to 250,000 have meters. Slightly more than half of the cities in the 25,000 to 100,000 population group have meters while the percentage is 40 for the 10,000 to 25,000 classification.

Though meters are intended primarily to control parking, they are a considerable source of municipal income in major cities. San Diego and Denver each collected nearly $300,000 from this source last year.

Initial problem among cities installing parking meters is informing the public on thir proper use. Colby, Kan., met the problem by having police drop two pennies into meters in front of cars parked overtime—during the first two weeks the meters were used—and leaving courtesy tickets asking violators to stop by the police station for a chat about regulation.

A report from Brighton, Ore., indicates that farmers may be more "allergic" to parking meters than city dwellers. The town recently voted to remove its parking meters because they apparently were causing farmers to take their business to neighboring communities where parking was free.

Police in Concordia, Kan., meanwhile, found that over a three-month period, 340 out of 660 cars tagged in metered areas were from out of the county. Of 340 out-of-city cars, 180 paid fines and 160 neglected to report.

A Simpler and Better Venturi Tube

J. C. Stevens
Consulting Engineer
Portland, Ore.

Contents in Brief—Venturi tubes assembled from flanged reducers and special equalizer rings are said to measure flow accurately, cost less than conventional models, permit rapid disassembly for inspection and minimize throat-pitting due to cavitation. Either standard cast-iron or fabricated welded-steel reducers may be used. The equalizer rings containing annular spaces register average pressure-heads. Experiments show that an average discharge coefficient of 97 percent is sufficiently accurate for all meters tested. When the tubes are equipped with valved, throat extensions, a coefficient of 94 percent may be used for all gate openings.

AN IMPROVED Venturi tube has been perfected that measures low-flow rates accurately and practically eliminates cavitation of the throat at high velocities. Another virtue is the fact that it can be assembled from standard, flanged, cast-iron, short and long reducers in conjunction with special pressure-equalizing rings at the inlet and throat, the short reducer and throat ring being turned down on a lathe to obtain a smooth approach section.

The cast-iron or bronze rings contain annular openings that evaluate the average pressure around the circumference of the pipe. This effect is conveyed through a tap and small-diameter piping to a manometer or piezometer tubes.

Venturi tubes of this construction are now in use on the water-supply systems of Salem, Ore. and Vancouver, Wash., where welded-steel meters on 36- and 20-inch lines have been in operation for more than ten years. Similar Venturi tubes are functioning satisfactorily in the hydraulic laboratory and on irrigation projects at Oregon State College. The laboratory installation, a 12x8-in. welded-steel unit on the discharge line of recirculating pumps, has been in service for over five years. In 1941, 8x5-in. and 4x3-in. welded-steel Venturi tubes were assembled and calibrated by experiments described herein. These units were then installed on dairy-department irrigation systems where they have operated successfully since that time.

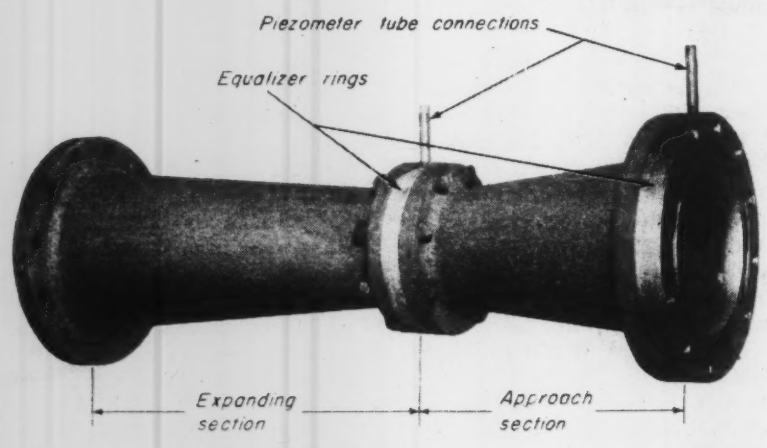


Fig. 1. Venturi tubes are assembled from standard cast-iron flanged reducers with special equalizer rings at the approach and throat.

Why the design is more accurate

As built today, Venturi tubes violate an important hydraulic principle. The throat tap is usually placed in the center of the throat (point *a*, Fig. 2). At this point an inaccurate effect is registered even if several manifold-connected outlets or an equalizer are used.

In passing through the throat, stream lines change direction. This action creates a type of *vena contracta*, the area of which is less than that of the throat, and lowers the pressure below that due to reduction in pipe areas. While the throat may be full of water, incipient eddies may be set up near its inlet boundary. If throat velocities are high, actual eddies may develop and upstream currents may be set up at or near the taps. If velocities are increased further, cavitation may result.

These conditions may be avoided by placing the throat tap just upstream from the point at which flow starts to change direction (point *b*, Fig. 2).

In the improved Venturi tube, the annular opening in the equalizer ring is located just ahead of the minimum internal diameter (Fig. 3). As flow lines are still converging at this point, the true throat pressure is registered.

To extend convergence beyond the annular groove, the equalizer ring and inlet reducer, bolted together through flanges, are turned down in a lathe. The average diameters of the approach and throat rings are carefully measured in the planes of the inlets. From these data, flow areas are calculated. Then, using the discharge formula evolved from Bernoulli's theorem, the calibration curve

Fig. 2. Conventional Venturi tubes are tapped in the throat center (a) where flow lines changing direction may create a form of vena contracta. Contact made before the flow-section is so diminished (b) increases accuracy of measurement.

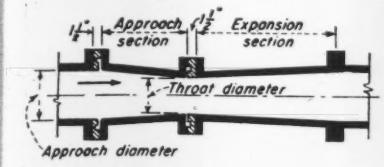


Fig. 3. Annular openings in the equalizer rings at the approach and throat register average pressure-heads.

Fig. 4. The equalizer ring with one tap into the annular opening is fabricated for use between standard flanges.

is computed. Recording and totalizing meters are made to fit this calibration.

Tests of improved Venturi tubes were made at the hydraulic laboratory of Oregon State College. The results are given in a post-graduate thesis, "Hydraulic Characteristics of Simplified Venturi Meters," Rex Alfred Elder, March, 1942.

Four meters—including the following tubes: 12x8 in. cast-iron, 12x8-in. flanged, welded steel, and 8x5-in. and 4x3-in. welded steel—were investigated. The sizes and dimensions of these units are given in Table I.

Testing for discharge coefficients

Two objectives were set up. The primary aim was to determine the discharge coefficient c for each meter. The secondary purpose was to evaluate the effect of elongated throats valved at the end. Tests were run with various gate openings.

The discharge formula for Venturi tubes,

$$Q = c\,K\,\sqrt{\triangle h} \qquad (1)$$

Where K = a constant for any ratio of pipe and throat area; c = a coefficient to be determined by test; $\triangle h$ = the differential head (ft.); and Q = the discharge (cfs.) was utilized in the experiments.

Results of tests on the first three tubes shown in Table I using equalizer rings but no throat extension are shown in Fig. 6. The 12x8-in. cast-iron meter showed a slightly higher c coefficient than the steel tube because less friction was developed in its shorter length. A coefficient of 97 percent is sufficiently accurate for all three meters.

Plotted against throat velocities, the c coefficients found from calibration of the 12x8 in. steel tube (Fig. 6) are compared graphically with those determined from an orthodox 12x6-in. meter (Fig. 7). The points on the standard curve are taken from an earlier study by J. W. Ledoux ("Venturi Tube Characteristics", *Trans.* Amer. Soc. of C. E., 1927, vol. 91, p. 572). The reduction in coefficients at low velocities is be-

TABLE I—DIMENSIONS OF IMPROVED VENTURI METERS TESTED

Venturi Tube	Diameter ft.	Converging Section Length in.	Angle	Diverging Section Length in.	Angle	Overall Length ft.	Length of Throat Extention ft.	Length of Valve in.
12x8-in.	1.005	16	6°–51′	26	4°–22′	3.75	None	None
Cast	0.682	..	....	..	....	....	.....	.....
Iron	.....	..	....	..	....	....	.....	.....
12x8-in.	1.000	..	....	..	....	.....	1.0	12
Welded	0.664	24	4°–46′	60	1°–55′	7.25	2.0	12
Steel	.....	..	....	..	....	....	3.0	12
8x5-in.	0.665	16	5°–16′	26	3°–15′	2.91	2.0	9.5
Steel	0.415	..	....	..	....	....	...	..
4x3-in.	0.336	10	2°–44′	16	1°–39′	2.41	1.0	8
Steel	0.255	..	....	..	....	....	...	..

TABLE II—TOTAL HEAD LOSS THROUGH SIMPLIFIED VENTURI TUBE

Tube	Throat extension with valve	Differential Head 1 Ft.	2 Ft.	4 Ft.	6 Ft.	8 Ft.	10 Ft.
12x8-in. CI	None	13	13	12	..	..	..
12x8-in. Steel	None	25	27	27	27	..	..
12x8-in. Steel	1.0 Ft.	39	38	38	38	..	..
12x8-in. Steel	2.0 Ft.	36	38	39	38	..	..
12x8-in. Steel	3.0 Ft.	38	38	39	40	..	..
8x5-in. Steel	None	25	25	26	27	28	28
8x5-in. Steel	2.0 Ft.	65	65	66	65	64	..

Fig. 5. Tests were run on the 12x8-in. tube with a 2-ft. pyralin throat extension. Heads were measured by means of water manometers.

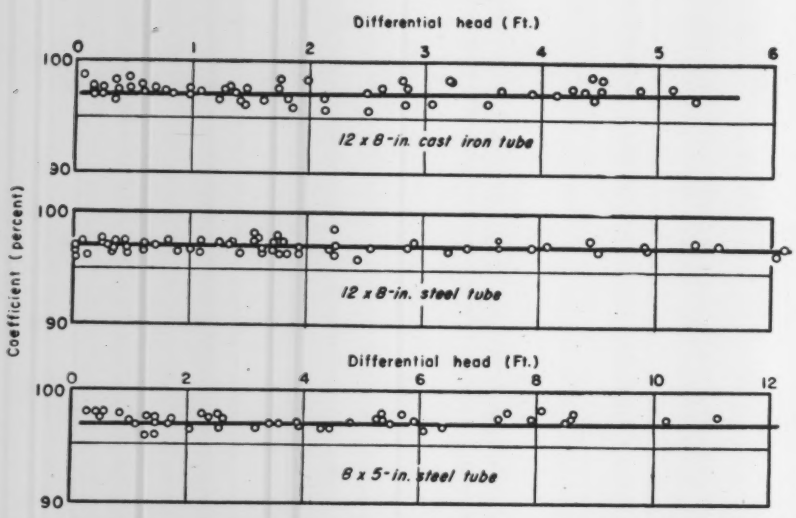

Differential head (Ft.)
Coefficient (percent)
12 x 8-in. cast iron tube
12 x 8-in. steel tube
Differential head (Ft.)
8 x 5-in. steel tube

Fig. 6. The discharge coefficient when plotted against various differential heads conforms closely to 97 percent.

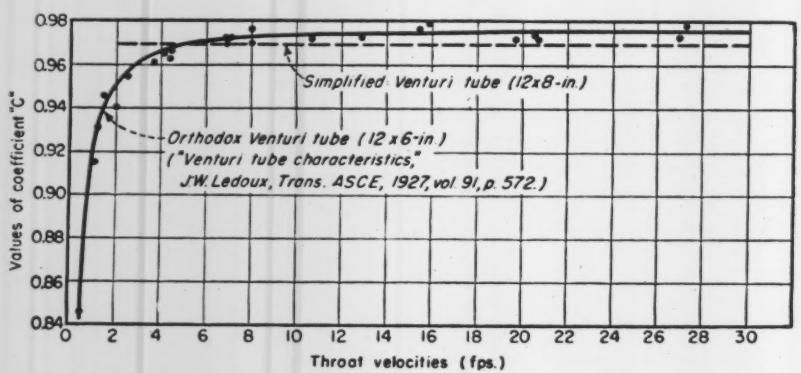

Values of coefficient "C"
Simplified Venturi tube (12x8-in.)
Orthodox Venturi tube (12 x 6-in.)
("Venturi tube characteristics," J.W. Ledoux, Trans. ASCE, 1927, vol. 91, p. 572.)
Throat velocities (fps.)

Fig. 7. For the conventional Venturi tube, the discharge coefficient varies widely at low throat velocities, but is constant for improved meter at all velocities.

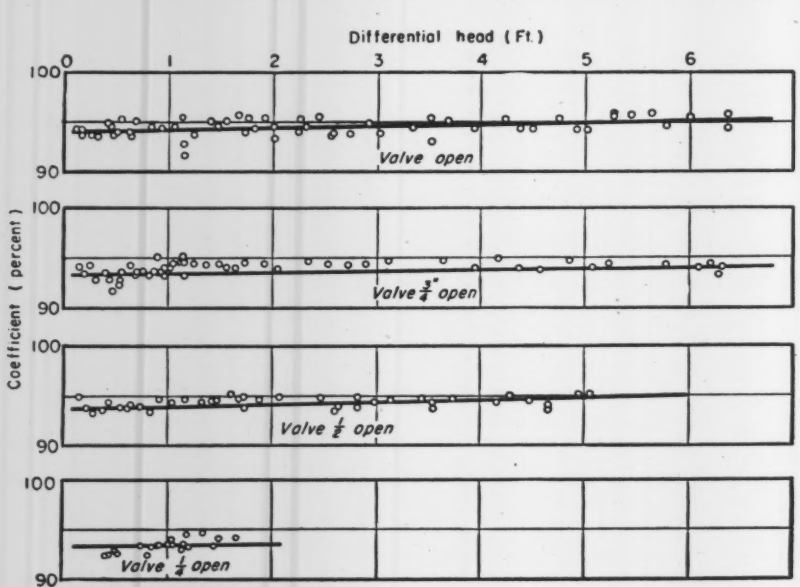


Fig. 8. Tests of the 12x8-in. tube with a 2-ft. throat extension and gate valve show that an average discharge coefficient of 94 percent can be used without appreciable error for all gate openings.

lieved due, in part at least, to bending of steam lines in the throat of the orthodox tube. If the discharge, Q, and the meter constant, K, in equation (1) are fixed, it is obvious that the coefficient, c, must be less than it would otherwise be.

The K formula for circular conduits is:

$$K = \frac{\pi}{4}\left[\frac{2g}{1-\left(\frac{d}{D}\right)^4}\right]^{1/2} \quad (2)$$

in which d and D are respectively the throat and approach diameters, in feet, and g is the gravitational constant. If a *vena contracta* is formed under high velocity, d becomes less than the throat diameter. This action increases the value of K which tends to compensate for the reduction in c. No appreciable *vena contracta* is created by low velocities so that the reduced coefficient is not influenced by other factors. These effects may explain the low values at low velocities and the almost constant results for higher velocities.

Another factor that must be considered is the pattern of velocity distribution at the two taps on the orthodox tube. This pattern directly affects the drop in velocity head. The improved Venturi meter maintains the same velocity distribution at both taps.

The lowest test point in Fig. 7 corresponds to a throat velocity of 0.5 fps. Laminar flow—an entirely abnormal condition for Venturi tube operation—may have existed in the approach and the larger portion of the reducer.

Effect of throat valve

Experiments were run on the 12x8-in., 8x5-in. and 4x3-in. welded-steel tubes with gate valves on the downstream end of throat extensions (Table I). Fitted with 1-, 2-, and 3-ft. lengths of 8-in. pipe, measurements were made on the 12x8-in. tube under various gate openings.

Test-found coefficients for the 12x8-in. meter with a 2-ft. throat extension and 8-in. valve are shown in Fig. 8. An average value of 94 percent may be used for all gate openings with no appreciable error. An examination of similar tests for other tubes and extensions (Table I) shows that an average coefficient of 94 percent may be also applied. This value is effective for the entire range of heads

used without involving errors greater than one percent.

On each test, an equalizer ring was included at the end of the outlet section so that the total head lost through the meter could be determined. The total losses in percent of the differential head are given in Table II.

Losses in the 12x8-in. steel tube were about double those of the 12x8-in. cast-iron unit, the latter being about half as long. In addition, the losses increased about 40 percent when extensions and a valve were used in conjunction with the 12x8-in. steel tube. For the 8x5-in. steel tube, the insertion of a 2-ft. extension and valve raised the loss about 2½ times.

Venturi tubes are subject to tuberculation and also to cavitation, just down-stream from the throat. Provision should be made for removing small tubes or entering large ones for inspection and repair. Such maintenance can be done readily on tubes assembled from standard reducers and equalizer rings.

Cavitation may result in pitting. Its severity will increase as throat velocity is raised. This action can be minimized by designing the tube for relatively low throat velocities and using water in the manometer instead of mercury. Adaptation studies are now being made of a photocel registering device that will, it is anticipated, improve measurements made in connection with Venturi tube flow.

Chromated Proteins Halt Corrosion

Chromated-protein coatings offering a convenient, inexpensive means of protecting metals—especially zinc, iron, brass, and aluminum—during outdoor storage in mildly corrosive atmospheres have been developed by Abner Brenner, Grace Riddell, and Robert Seegmiller of the National Bureau of Standards (Jour. Electro Chemical Society, Mar. 1948). The protective value of such films is somewhat better than that afforded by chemical surface treatments and is much superior to that of corrosion-inhibited oils and waxes. The metallic surface to be coated is first dipped in casein, albumin, or gelatin; the resultant film is then impregnated with chromate, which both hardens film and inhibits corrosion.

Wartime scarcity of many nonferrous metals led to extensive substitution of ordinary carbon steel for copper, brass, aluminum, and stainless steel in both military and civilian uses. While steel was generally protected with zinc coatings, the tendency of zinc to form objectionable corrosion products brought about a widespread use of chromate films on zinc. These films were formed on the surface by chemical attack in aqueous chromate solutions and, though only a few hundred-thousands of an inch thick, were useful in inhibiting corrosion. As this was apparently due to presence of minute amounts of soluble chromate, slowly liberated by moisture action, it seemed possible that an enhanced corrosion resistance might be obtained by applying a large quantity of chromate to the metal surface. The National Bureau of Standards therefore undertook an investigation in which proteins were found to increase amount of chromate on the metal surface.

Principal constituents of chromated-protein films are a corrosion inhibitor for metal, a protein which acts as a vehicle for the inhibitor, a hardening agent, and a bactericide to prevent putrefaction of protein. Chromate always serves as the inhibitor and may act as the hardening agent and bactericide as well.

Four functioning constituents of the film can be applied in a single step or in several steps, according to compatibility of agents and degree of protection desired. In the "two-step" process, which is usually the most satisfactory, the metal is first dipped into an aqueous protein solution. When the resulting protein film is dry, it is immersed in an acidified chromate solution for one-half to three minutes and allowed to dry without rinsing.

Preparation of protein solution varies somewhat with each protein. Gelatin is dissolved in water by heating gently; albumin may be dissolved in water at room temperature by stirring; casein is dispersed in water and brought into solution with the addition of 25 milliliter of ammonium hydroxide per liter of solution. The chromate solution contains chromic acid (0.5 to 2 percent) or a dichromate of zinc, iron, or nickel (1 to 10 percent).

A simpler "one-step" method of forming inhibiting film by a single immersion in a solution containing both protein and chromate has the disadvantage that the solution slowly deteriorates.

A solution of this type is made by adding ammoniacal zinc chromate to a solution of casein. The resulting preparation should contain about 10 percent of casein and the equivalent of about 5 percent of zinc chromate.

Chromated-protein films are yellow and, unless opaque pigments have been added, are transparent. Flexibility and adhesion are sufficient to prevent cracking or separation when the metal is bent. They are not injured by heating to 150 deg. C., whereas most chromate films produced chemically on zinclose much of their protective value at 100 deg. C. Thickness depends principally on concentration and viscosity of protein solutions, varying with type of protein up to about 0.0002 inch. This is in contrast to proprietary chromate films, which usually are not more than 0.00003 inch thick.

When freshly prepared and hardened, films are almost insoluble in water and are so hard that they cannot be scratched with the finger nail. Exposure to light further hardens some films and renders them still less soluble.

Films removed with sodium hydroxide

Films may be quickly removed from metal parts by application of an alkaline solution such as 5-percent sodium hydroxide. Their removal is thus more convenient and less hazardous than removal of oil films with toxic or inflammable organic solvents.

Protein solutions, unlike baths used for direct phosphate or chromate treatments, do not become exhausted and require replenishment, but are fairly stable for long periods. While chromated-protein films are superior to direct phosphate or chromate coatings or to oil films for corrosion prevention, their life is less than that of suitable paint coatings. They are more effective on large, regular surfaces than on the sharp edges and corners of small objects like nuts and bolts, where the film tends to pull away.

Mortar-Coated Thin Steel Shells For Distribution Main Service

Bids are being called for supplying steel pipe with cement-mortar lining and coating to supplement the supply of small water pipe for distribution main service in the East Bay Municipal Utility District which serves Oakland, Calif., and other nearby cities and unincorporated areas. Officials hope that this will give manufacturers of such pipe an opportunity to bid on suppliers' contracts and thus make small diameter water pipe more available to the district. Such a move was prompted by the relatively short supply of the standard types of distribution-system pipe in recent years.

It is proposed to stockpile various sizes for new construction and system replacement. Steel of the lightest gage possible for the service intended is called for and this is to have cement-mortar lining and coating. The lining will be centrifugally spun and the coating will be applied over a wire wrapping—intended to provide bond for the coating and not necessarily to act as reinforcing. Pipe lengths will have plain ends with the lining extending to the end and with the coating 2 in. from the end.

Field joints will be made by butt welding. The outside will be plastered after it has been welded. Tests indicate that there will be no damage to the inside coating from electric welding or gas cutting.

How taps will be made

Taps will be made by one of two methods. In both methods the outside of the pipe in the vicinity of the tap is stripped of its coating and the wire wrapping is either cut or spread. Then, under one scheme, a plate is welded to the pipe and both are tapped through, while under the second method, a nipple is welded to the pipe and a threaded joint made. In either case, the outside is replastered after the tap is completed.

In experimenting with such taps, the district found that the mortar on the inside of the pipe broke away in a conical shape, leaving a minimum of exposed metal.

The pipe will be ordered so that the outside diameter of the steel shell is identical with that specified in standard size cast-iron pipe. This will enable standard cast-iron fittings to be used on joints. Procedure for making such joints will be identical with cast-iron pipe practice.

The pipe shells will be 30 ft. long and made of rolled steel with one longitudinal or spiral weld. One butt weld is permitted so the shells can be made of two pieces of steel if necessary. A 300-psi. pressure test is called for before lining or coating with mortar.

The lining will be of the centrifugal type similar to that usually specified for cast-iron pipe. A 1 cement to 3 aggregate mix to test 4,000 psi. at 28 days will be used. The lining machine will be required to develop about 4,000 peripheral fpm.

The wire wrapping will consist of ¼-in. steel wire placed under more than 4,500-psi. tension. The pipe will then be coated with ½ in. of cement mortar, either by cement gun or rotary brush-placing methods. A 10-day cure is specified, five days under wet burlap and five more days during which the pipe must be kept wet.

Engineers in charge

J. S. Longwell is chief engineer and general manager of the East Bay Municipal Utility District and J. D. DeCosta is engineer in charge of distribution.

Rotating Screen for Algae Removal Proposed for London Waterworks

A rotating screen of very fine mesh will be utilized in the first treatment step to remove algae from impounded water in the proposed filtration plant at Ashford Common, London, England. As a result of experiments conducted at London's Surbiton Waterworks, the micro screen used in conjunction with slow sand filtration was found to be as effective as primary filters in removing algae. This innovation in purification practice as well as an outline of the proposed treatment is reported in the September 1947 issue of *Civil Engineering* (England).

Limited by inadequate filtration capacity, the Metropolitan Water Board is faced with the serious problem of meeting an ever-expanding demand for water in the London area. In 1946, 332 mgd. of water were supplied, and it is estimated that the 1947-48 draft will average 350 mgd. and approach a maximum of 455 mgd. during the summer. At present the filtration plant can furnish about 315 mgd., and wells can account for another 43 mgd. To meet the deficiency of 95 mgd., the filtration works at Ashford Common will be built.

Water for the plant will be obtained primarily from the Queen Mary reservoir but provisions will be made to tap the existing 72-in. conduit and the Staines aqueduct and to draw from the proposed Wraysbury and Datchet reservoirs.

The purification process will consist of aeration by cascading; passage through a fine screen to remove algae; slow-sand filtration; application of granular carbon; chemical treatment; and finally, retention in combined contact and balancing tanks to permit chemical sterilization.

The cost of installing micro screens, it is said, would be less than primary filters of equal capacity. Other advantages reported are: smaller head loss, simpler concrete work, and more rapid installation.

Installation cost lowered

Slow-sand filtration will be provided in 32 beds, each about ¾ acre in area. Sand washing apparatus, sand storage bins, mains and drains will be included. The beds will be raised above the existing ground level to avoid possible contamination from groundwater.

The project for expanding the filtration facilities has been submitted to the Board of Works and Stores Committee for final approval.

Lime Recalcining Plant Designed for Alternate Processes

Thomas B. Henry
Partner

Bernal H. Swab
Sanitary Engineer

Jones & Henry, Consulting Engineers, Toledo, Ohio

Contents in Brief—To eliminate disposal of lime-softening sludge in lagoons as well as to reduce operating costs by use of reclaimed lime, a recalcining plant will be built at the Lima, O. waterworks. Either of two processes will be employed depending upon the result of competitive bidding. Each process will include sludge dewatering by continuous centrifuges, grinding of cake and drying of pulverized particles in wet and dry cyclones. Dried calcium carbonate, in each case, will be calcined in furnaces at temperatures of about 1,800 deg. F. Powdered quicklime will be in the end product in one process and pellets of calcium oxide in the other.

PLANS for a lime recovery plant at the Lima, O., waterworks include provisions so that either of two recalcining process obtained under competitive bidding may be installed with a minimum of alteration.

For reclaiming lime from sludge the two processes approved are: the C-E Raymond Flashing Drying and the Dorrco Fluo Solids systems.

After a study of various installations, it was decided to use continuous centrifuges for sludge dewatering and classification, and separation of calcium carbonate from impurities—such as magnesium, iron and aluminum compounds, silica and organic matter. In addition, calcium-oxide content is increased sufficiently by centrifuge classification to insure high-grade lime even after reuse.

Investigations of several methods of drying centrifuge cake indicated that the C-E Raymond Flash Drying system was most applicable for the Lima installation. The drying system will be a two-stage, counter-flow type designed for maximum heat recovery and minimum vent losses. A single vent from the wet stage will serve the dual purpose of pre-drying carbonate cake and wet washing vent gases.

As the plant site is adjacent to a residential district, it was considered advisable to reduce vent losses to an absolute minimum by washing exhaust gases in a dust collector. The temperature of gases leaving the vent will be about 160 deg. F., indicating good thermal efficiency.

A number of types of furnaces for calcining and generating heat for the flash-drying system were also studied. Results from pilot-plant operations indicated the type of furnace developed at Marshalltown, Iowa and the Fluo Solids furnace developed by the Dorr Co. were applicable to this installation. Both furnaces require centrifuging and flash drying for preparing calcium carbonate for calcination.

The Dorrco Fluo Solids system requires addition of soda ash to centrifuge cake before drying and produces a lime pellet approximating $\frac{1}{16}$ in. in diameter. The Raymond system produces a very fine lime powder. Both furnaces will convert about 95 percent of available carbonate into calcium oxide.

Either furnace can be operated on an intermittent basis and started in 30 min. after shutdowns without detrimental effect. No fuel is consumed between operating periods. These features made possible design of a system to process the present volume of lime-softening sludge in about

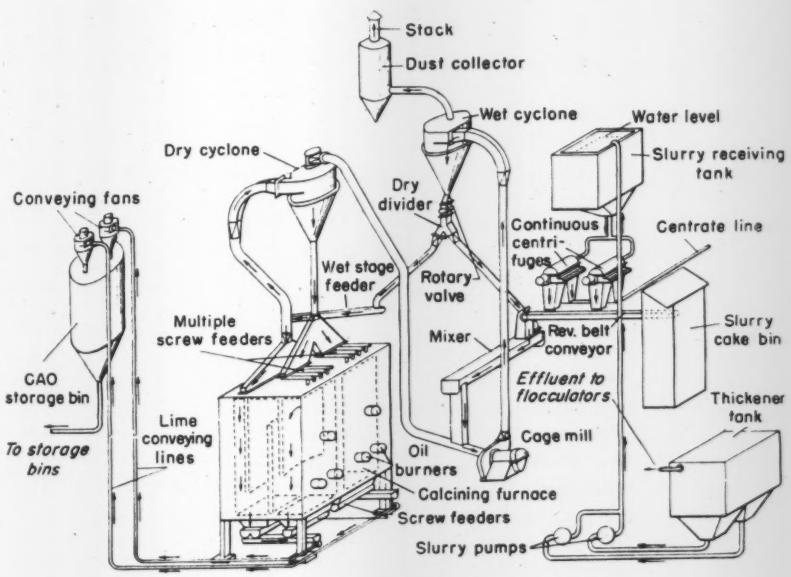


Fig. 1. In the C-E Raymond system, thickened sludge (lower right) dewatered in twin centrifuges is ground in a cage mill and lifted to the wet cyclone by hot gases. From the wet cyclone part of calcium carbonate is fed into the recalcining furnace stack and conveyed to the dry cyclone by gas. The dried material is then fed into the furnace for calcination. Powdered quicklime collected in hoppers under the furnace is conveyed to storage bins pneumatically.

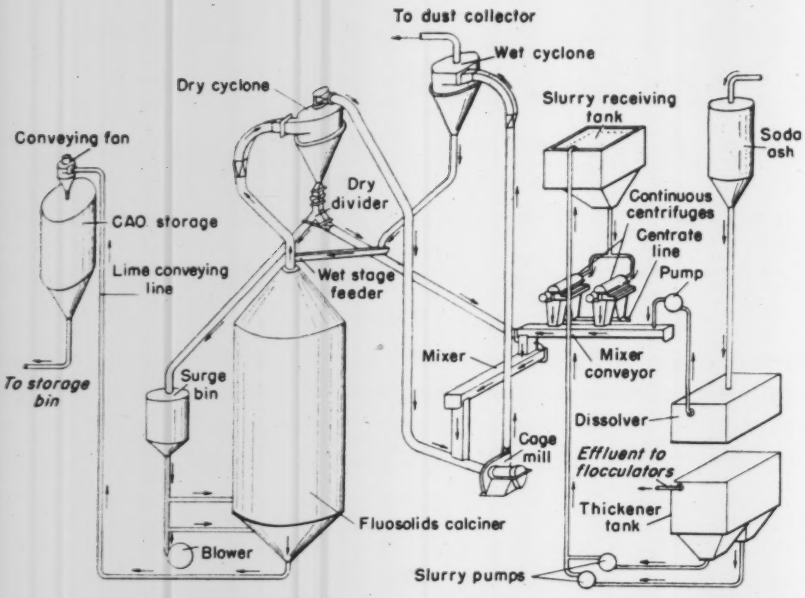


Fig. 2. In the Dorrco Fluo Solids process, centrifuge cake mixed with soda ash is ground in the presence of hot gases (lower center) which lifts the fine particles first to the wet and then to the dry cyclone. From the dry cyclone, dried material passes into the surge bin and then into the calciner where combustion is maintained by fuel oil and an air draft. Pellets of calcium oxide that drop into the furnace hopper are conveyed pneumatically to storage.

8 hr. per day. Future loading increases will be handled by extending the operating period. Costly additions or new buildings will not be required. Both systems can be operated with a minimum of personnel.

One calcining system described

In the Raymond system (Fig. 1), sludge will be pumped from settling basins to thickener tanks. Solids concentration is expected to be 15 percent or better. Thickener overflow will be skimmed by weirs and returned by gravity to the influent of flocculation basins. Thickened sludge will be pumped from thickener-tank hoppers to the receiving tank. A constant level will be maintained in the receiver float controls; any overflow will drain back to the thickeners. The receiving tank with a slow-speed stirrer will maintain uniform sludge consistency.

Sludge will flow by gravity to either or both of the continuous centrifuges where excess water and a large percentage of magnesium compounds and other impurities will be rejected and discharged to the sewer.

First step in drying dewatered sludge will be to mix it with a quantity of dried material to disperse remaining moisture and eliminate the stickiness of wet sludge cake.

The mixture will then be passed through a high-speed cage mill where the finely divided product will be brought into contact with hot gases from the dry cyclone. As moisture content is reduced to about seven percent, fine material will be conveyed to the wet cyclone in the gas stream.

In the wet cyclone gas will be separated from powdered calcium carbonate and passed to atmosphere through a dust collector. Calcium carbonate will drop through a rotary valve and dividing device, part being returned for mixing with sludge cake, and the remainder being fed into the recalcining-furnace stack. Stack gases will be maintained at 1300 deg. F.

A small portion of the calcium carbonate will settle into the calcining furnace but most of it will be lifted by the gas to the dry cyclone. During the rise, moisture content will be reduced to about one percent.

Hot gases from the dry-cyclone exhaust will pass to the cage mill to serve the first-stage drying cycle.

Dried carbonate from the dry cyclone will drop into multiple-screw feeders serving the recalcining furnace. Calcination will take place with temperature at 1,700 to 1,900 deg. F. Powdered quicklime will be collected in hoppers at the bottom of furnace and conveyed by pneumatic means to a storage bin.

The Dorrco system involves a different operating procedure (Fig. 2). Centrifuge cake will be mixed with a small amount of soda ash to control pellet formation before mixing with dry powdered cakes. The mixed cake will then be finely ground in a cage mill in the presence of hot gases. The gases will lift fine material to the wet cyclone from which partially dried solids will be fed into the calciner stack. In passage to the dry cyclone the remaining moisture will be removed by hot calciner gases to about one percent residual.

Leaving the dry cyclone material will be divided, part being returned to be mixed with centrifuge cake, and the remainder being dropped into the surge bin ahead of the calciner feed.

Carbonate will be fed into the active zone of the calciner from the surge bin. Sufficient fuel oil will be injected to maintain a temperature of about 1750 deg. F. Air to support combustion and maintain the material in "fluidized" state will be supplied by a blower.

Calcium oxide pellets formed

As conversion to calcium oxide in the calciner takes place, the lime will form into pellets which increase in size until they can not be maintained in suspension in the hot gases. As pellets fall to the bottom of the calciner, they will pre-heat the incoming air. Pellets will be drawn from the calciner and blown to storage pneumatically. Temperature of quicklime will be about 300 deg. F.

Provision has been made in design to dispose of softening sludge in the form of centrifuge cake. This procedure will be employed when it is undesirable to operate recalcining facilities or during emergencies. Centrifuge cake will be conveyed by belt (not in Fig. 2) to a bin outside the building for disposal in trucks.

An existing pneumatic conveyor will be extended from the chemical building to carry finished lime from the storage bin in the recalcining building to existing bins over present feeders in the chemical building.

E. E. Smith is general superintendent of the Lima Water Department. All planning for improvements was done by Jones and Henry, consulting sanitary engineers, Toledo, O.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Fort Peck Powerhouse

Sir: We have read with much interest the article on the Ft. Peck hydro plant (*ENR* Mar. 18, 1948 vol. p. 408). However as contractors with the U. S. Engineer Office at Fort Peck, Mont., we were disappointed to find that no mention was made of this company, which during 1942 constructed the powerhouse portion of the structure and installed the turbine and ventilating equipment, and which has at this time two contracts for the erection of the surge tanks and superstructure, and the construction and installation of the interior finish and appointments for the entire building.

Chicago Bridge and Iron Co., under subcontract with us, furnished and erected the surge tanks. The powerhouse and surge tank foundation was performed by other contractors under direct contract with the Corp of Engineers.

C. C. ADAMS,
Chief Engineer
Fegles Construction Co., Ltd.
Minneapolis, Minn.

Composite Girder Bridges

Sir: The great interest in composite girder bridges shown by several correspondents in the discussion started by Louis Balog (*ENR* Jan. 8, vol. p. 64) is very much shared by structural engineers in this country and abroad. David H. Crater (*ENR* March 4, vol. p. 372) and Homer Hadley (*ENR* March 18, vol. p. 440) have dealt with the subject chiefly by engineering intuition. The consensus seems to be that while there is great likelihood of composite action through bond alone, adequate safety factors against excessive shear in the contact area between the concrete slab and the steel member should be provided for.

In this connection, may I point to the very extensive tests made by the Swiss Federal Materials Testing Institute in Zurich under the direction of Prof. M. Ros (Report No. 149, March, 1944). In this report, the question of composite action is dealt with for building construction as well as for bridges: In the latter case, the fatigue of the welds between steel beams and shear connectors is considered.

In a recent article in the *Structural Engineer*, London, Feb., 1948, F. G. Thomas of the British Building Research Station mentions a number of tests made under his supervision on composite action. However, he combines the relief of the stringer by lateral distribution with that of composite action, also mentioned by Mr. Balog. Mr. Thomas writes:

"These tests have shown that a considerable degree of lateral distribution exists even when the concrete slab has cracked. Also, even when a slab is cast on top of unencased steel joists without mechanical anchorage to aid the interaction of the steel and concrete, friction is sufficient to induce appreciable composite action. However, some special shear connectors fixed to the joists appear to be desirable if full allowance for such action is to be made.

"The rigorous mathematical analysis of the effects of a concentrated load on a non-isotropic system is a complicated and lengthy process. However, a suitable method of calculation has been developed during the past year, and it is hoped to publish an account of this work in 1948. Since this analysis is based on the elastic theory it will be necessary to check its agreement with results of experiments before using it as a basis for design rules."

Mr. Thomas' idea, regarding lateral distribution of concentrated loads on non-isotropic systems, was taken up experimentally by the Germans in the late 1930's. Regarding this, I would like to refer to articles by Prof. Karl Schaechterle in the *Bautechnik* for Sept. 8 and 15, 1939, based on the work of Christian Ostenfeld, Copenhagen, 1930, (Ju Gjellerup).

Mr. Schaechterle mentions model tests of extreme simplicity made by Prof. August Graf and F. Kauffmann, and verified by himself by measurements made on German bridges. He recommends such model tests in preference to a purely mathematical treatment of non-isotropic systems for greater simplicity and dependability.

Mr. Thomas also wrote:

"It is becoming increasingly important that research workers should discuss their investigations with those for whose benefit the work is being done, *at an early stage in their studies*. It is important, too, that research workers throughout the country, and indeed the world, should work together as a team in their search for truth. Too often in the past have two or more investigators carried out independently almost identical pieces of research and arrived at similar conclusions sometimes of world-wide importance, at about the same time; had they been working in collaboration, scientific progress would have been more rapidly advanced."

L. COFF
Consulting Engineer,
New York, N. Y.

Wind and Ice

Sir: The caption for the cover picture of the Feb. 26 issue of Engineering News-Record states "Ice, tide and wind combine to weaken wood pile bents under a 130-ft. section of highway bridge near Rehoboth Beach, Del. Section gave way under heavy truck." We do not believe that the bridge failed through any action of a heavy truck and would like to correct this impression.

A truer statement was made by our division engineer, E. V. Rose, who explained that an unusual combination of ice, wind, tide and tide swells caused this disaster. Very heavy ice from the ocean came into the inlet and there was a wind from the northeast with a velocity of around 35 mph. The tide was running into the inlet with heavy swells. This combination of ice and tide we believe caused the failure. It resulted probably from a combination of moment and shear on the piles, due to the heavy ice pressure and a depth of 30 ft. of water at the site. The depth, of course, caused a large moment in the piles.

Our purpose in writing is to correct the impression that a heavy truck would cause the bridge to collapse.

A. G. LIVINGSTON
Bridge Engineer
Delaware Highway Department

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

New Water Service Pulled Under Pavement

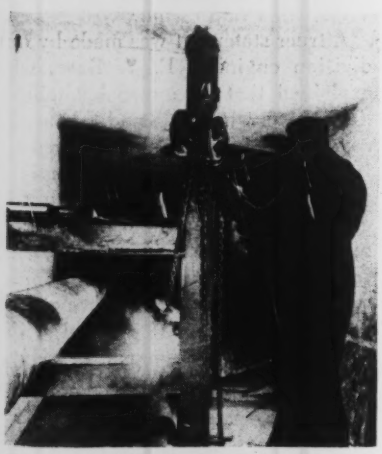
The waterworks department of Kirkland Lake, Ontario, Canada recently had to replace a badly corroded and leaking ½-in. galvanized iron service under a busy downtown street with a ½-in. copper pipe. To prevent traffic congestion and pavement damage, the copper tube attached to the original service was drawn under the street as the old pipe was jacked out. The job took about one hour.

Excavations were made at the curb cock and the main. To the disconnected galvanized service at the curb, a short length of iron pipe was joined by means of a threaded coupling, and halfway into the open end a ½-in. round steel rod was inserted and riveted to the pipe. Then the copper tube was run onto the rod, butted to the pipe, and riveted to the rod.

At the main, the iron pipe was disconnected and gripped by a manually-operated 15 ton jack. The old pipe then was jacked out, drawing the copper tube into its place. To break initial friction, two men were required to operate the jack, but thereafter one man did the work easily.

Jacking was done in 2-ft. increments, each withdrawn section being cut off and the jack grip shifted to the protruding pipe.

This procedure was conceived and put into operation by G. Guinta, water department foreman, under the supervision of F. G. Browne, waterworks engineer.—H. E. ARCHIBALD *Township Engineer Kirkland Lake, Ontario Canada.*



Technique of "roll welding" a pipe consists of rigging a block and fall at each end. By unwinding, the pipe is turned allowing the welder to work in the flat or downhand position, increasing the speed of operation. — Air Reduction Sales Co., New York 17, N. Y.

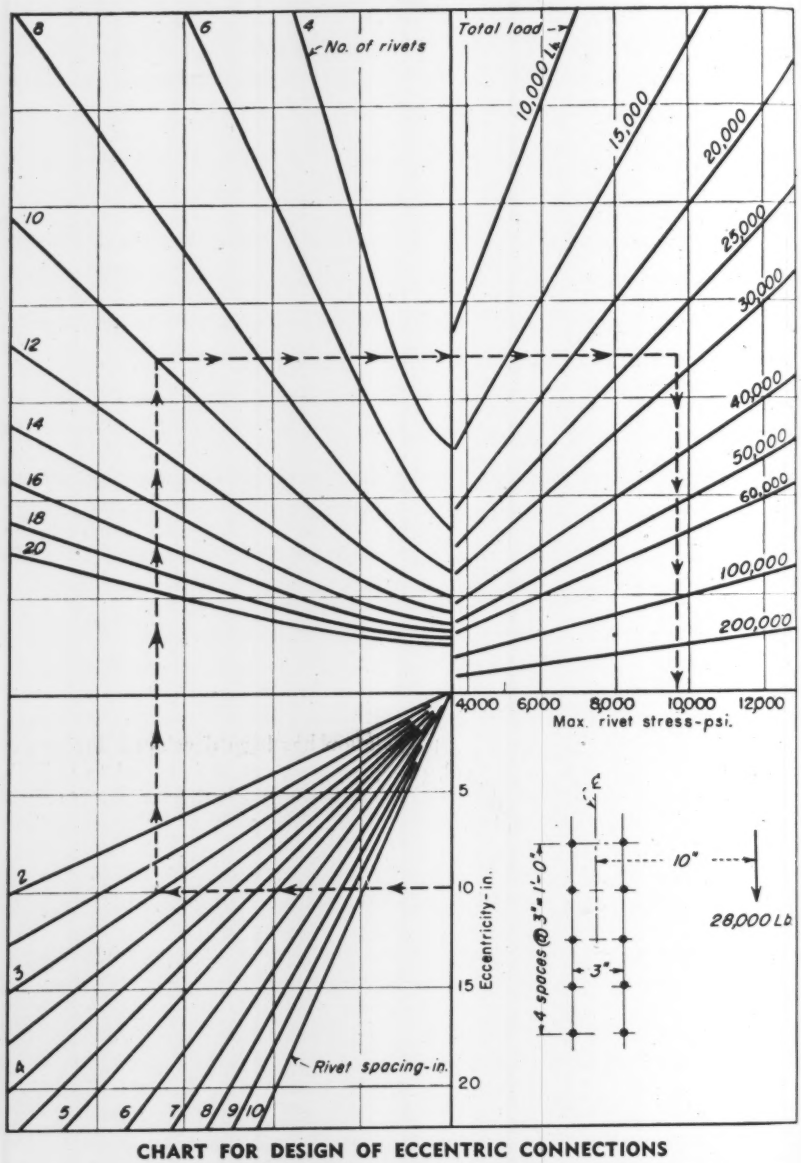


CHART FOR DESIGN OF ECCENTRIC CONNECTIONS

By means of the above chart, the maximum resultant stress in the rivets of a two-row connection may be obtained rapidly, even when the applied load is eccentric. For example, for the case shown in the lower right-hand corner, where a group of rivets, spaced at 3 in., carries a load of 28,000 lb. with an eccentricity of 10 in., the stress is found to be 9,700 psi. by following the dotted line, starting at the lower right with the eccentricity.—Odd Albert, Belmar, N. J.

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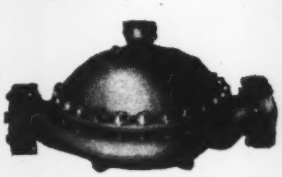
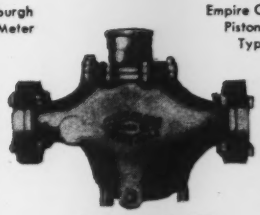
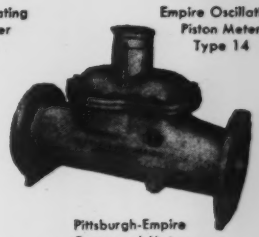


Pittsburgh Disc Meter, Large Capacity Type

Empire Oscillating Piston Meter Type 16



Pittsburgh Eureka "B" Meter, Current Type



Pittsburgh-Empire Compound Meter Single Register Type

UNIT PRICES BID BY CONTRACTOR

Flood Protection, Williamsport, Pa.

OWNER: U. S. Engineers, Baltimore, Md.; E. H. Luetze, resident engineer.

PROJECT: Williamsport Flood Protection Project-Unit 3, Pumping Stations located along left bank of West Branch of Susquehanna River in the City of Williamsport, Lycoming County, Pa. Work includes: construction of reinforced concrete and brick pumping stations at Hepburn, Basin, and Penn Streets; furnishing and installing automatic flood gates, sluice gates, and flap valves; furnishing and installing motor-driven pumping units; construction of power and lighting system and transformer substation for each pumping station; and gravel surfacing of pumping station terraces and access road.

CONDITIONS: All materials are to be furnished by contractor. Access to job site is available by both rail and highway. Stipulated contract time is 730 days from date of notice to proceed. Stipulated minimum labor wage rates per hour are: carpenters, $1.50; cement finishers, $1.75; electricians, $1.75; structural iron workers, $2.25; bulldozer operators, $1.75; tractor operators, $1.75; truck drivers, dump and flat top, $1.00; and laborers, $0.90.

BIDS: Three bids were received, ranging from the contract low of $1,087,613.00 to $1,296,263.00. Contract was awarded February 5, 1948.

LIST OF BIDDERS:

1. Lycoming Const. Co., Inc., Williamsport, Pa. (contract) $1,087,613.00
2. The Tuller Const. Co., Red Bank, N. J. $1,124,997.00
3. Merritt-Chapman & Scott Corp., New York, N. Y. 1,296,263.00

	Item	Quantity	Unit Prices (1)	(2)	(3)
1	Clearing of sites and diversion and care of water	lump sum	$125,000.00	.....	.....
2	Removal of concrete & masonry structure	200 cy	7.00	$16.00	$10.00
3	Excavation—common	9,700 cy	2.10	3.00	1.25
4	Excavation—borrow	200 cy	4.00	1.25	2.15
5	Sheeting and shoring				
	a. Type A	4,160 sf	3.10	3.50	4.20
	b. Type B	400 sf	3.00	1.50	2.75
6	Backfill—compacted	6,100 cy	1.25	1.40	2.40
7	Derrick stone	70 cy	20.00	20.00	18.00
8	Steel sheet piling	600 sf	4.50	2.00	4.20
9	Concrete				
	a. Reinforced	3,660 cy	54.00	45.00	67.00
	b. Gravity	70 cy	49.00	25.00	62.00
10	Portland cement	4,665 bbl	5.20	5.00	5.00
11	Steel reinforcement	536,000 lb	.115	.10	.14
12	Rubber water stops				
	a. Type A	380 lf	3.00	2.50	4.25
	b. Type B	380 lf	2.00	1.20	3.00
14	Cast iron	1,300 lb	.30	.20	.70
15	Cast iron pipe	17,000 lb	.21	.11	.20
16	Steel pipe—30" diameter	2,700 lb	1.00	.35	1.15
17	Cylindrical steel lining	20,000 lb	.65	.50	.43
18	Trash racks & catwalk				
	a. Steel trash racks	23,000 lb	.35	.28	.55
	b. Catwalk	8,200 lb	.40	.33	.30
19	Miscellaneous metal	22,000 lb	.50	.40	.60
20	Automatic timber flood gates	3 ea	4,850.00	4,000.00	1,850.00
21	Sluice gates				
	a. 36" by 36"	1 ea	4,500.00	3,500.00	3,500.00
	b. 60" by 60"	8 ea	6,550.00	6,000.00	6,100.00
	c. 72" by 72"	1 ea	8,000.00	7,000.00	7,500.00
	d. 108" by 108"	2 ea	17,000.00	16,000.00	17,600.00
	e. 48" diameter	1 ea	5,400.00	5,000.00	5,100.00
	f. 78" diameter	1 ea	12,000.00	11,000.00	12,000.00
22	Flap valves				
	a. 4" diameter	3 ea	80.00	40.00	90.00
	b. 10" diameter	1 ea	150.00	180.00	165.00
	c. 14" diameter	1 ea	280.00	240.00	250.00
	d. 42" diameter	2 ea	1,450.00	1,450.00	1,250.00
	e. 66" diameter	4 ea	4,500.00	4,000.00	4,100.00
23	Motor operated gate valve—30"	1 ea	3,350.00	2,800.00	2,750.00
24	Pipe handrailing	2,100 lb	.55	.30	.60
25	Gravel surfacing	165 cy	6.00	5.00	28.00
26	Pressure grouting—sewer lining	200 cf	11.00	3.00	8.00
27	Pumping station superstructures				
	a. Hepburn Street (Unglazed tile backed walls)	lump sum	50,000.00	.....	.....
	b. Basin Street (face brick backed walls)	lump sum	6,000.00	.....	.....
	c. Penn Street (face brick backed walls)	lump sum	22,000.00	.....	.....
28	Traveling cranes				
	a. 5-ton	1 ea	3,000.00	2,600.00	2,100 (a)
	b. 15-ton	1 ea	4,000.00	4,800.00	2,850 (a)
29	Float gages				
	a. Hepburn Street	3 ea	270.00	200.00	350 (a)
	b. Basin Street	1 ea	270.00	200.00	300 (a)
	c. Penn Street	1 ea	270.00	200.00	310 (a)
30	Propeller pumps				
	a. 44,000 g.p.m.	2 ea	16,500.00	25,000.00	26,000 (a)
	b. 112,200 g.p.m.	4 ea	43,650.00	57,500.00	61,000 (a)
31	Centrifugal pumps				
	a. 100 g.p.m.	1 ea	1,200.00	1,500.00	2,000 (a)
	b. 250 g.p.m.	2 ea	1,400.00	1,800.00	2,500 (a)
	c. 2,500 g.p.m.	1 ea	5,200.00	5,500.00	8,700 (a)
	d. 5,000 g.p.m.	1 ea	12,419.00	9,000.00	13,200 (a)
32	Power and lighting systems				
	a. Hepburn Street	lump sum	4,930.00	.....	.....
	b. Basin Street	lump sum	5,200.00	.....	.....
	c. Penn Street	lump sum	5,800.00	.....	.....
33	Electrical switchgears				
	a. Hepburn Street	lump sum	24,000.00	.....	.....
	b. Penn Street	lump sum	12,800.00	.....	.....
34	Transformer substations				
	a. Hepburn Street	lump sum	28,700.00	.....	.....
	b. Penn Street	lump sum	21,900.00	.....	.....
35	Substation enclosures				
	a. Hepburn Street	lump sum	700.00	.....	.....
	b. Penn Street	lump sum	850.00	.....	.....
36	Bituminous railroad crossing	200 sy	10.00	3.00	12.00

Sewer Extension, Idlewild, New York

OWNER: The Port of New York Authority; John M. Kyle, Chief Engineer.

PROJECT: Construction of an extension to the Thurston Sewer at New York International Airport, Idlewild, Queens County, New York. Work includes 52,500 cu. yds. of excavation, 2,750,000 lbs. of concrete reinforcement, installation of 9,000 lin. ft. of piles; water, gas and concrete pipes, 2,700 sq. yds. of road pavement, and installation of Venturi meter.

CONDITIONS: Owner will furnish Venturi tube, manometer and meter. All other materials are to be furnished by contractor. Access to job site is available by highway. Project is to be completed within 12 months after date of commencement. Prevailing minimum wage rates per hour are: bricklayers, $2.75; carpenters, $2.75; structural iron workers, $3.00; hoisting engineers, $3.00; electrical workers, $2.50; and common labor, $1.50.

BIDS: Twelve bids were received, ranging from the contract low of $767,410.00 to $1,102,900.00. Contract was awarded February 10, 1948.

LIST OF BIDDERS:

1. Gull Contr. Co., Inc. & L. G. Defelice & Son, Inc. Flushing, N. Y. (contract) $767,410.00
2. Hendrickson Bros., Inc., Valley Stream, N. Y. 774,018.00
3. Andrew Catapano & Co., Glendale, N. Y. 780,825.00
4. Millman & Nazzaro Const. Corp., Brooklyn, N. Y. 838,490.00
5. Delhan Const. Co., Inc., Brooklyn, N. Y. 846,110.00
6. Horn Const. Co., Inc., New York, N. Y. 857,815.00
7. T & T Contr. Co., Brooklyn, N. Y. 875,575.00
8. Angelo Paino & Co., Inc., Brooklyn, N. Y. 912,885.00
9. Stock Const. Corp., New York, N. Y. 947,610.00
10. Lawrence J. Rice, Inc., Forest Hills, N. Y. 982,890.00
11. Del Balso Const. Corp., Brooklyn, N. Y. 1,044,570.00
12. Charles F. Vachris, Inc., Brooklyn, N. Y. 1,102,900.00

(*Continued on page* 123)

Sewer Extension, Idlewild, New York

(Continued from page 122)

	Item	Quantity	Unit Prices (1)	(2)	(3)
1	Excavation	52,500 cy	$1.35	$1.50	$3.00
2	Fill	7,000 cy	.40	1.00	.50
3	Concrete	15,200 cy	22.75	18.75	16.00
4	Portland cement	23,600 bbl	3.50	4.00	3.00
5	Concrete reinforcement	2,750,000 lb	.08	.095	.09
6a	Miscellaneous iron and steel	16,000 lb	.15	.30	.30
6b	Water pipe	44,000 lb	.30	.30	.30
6c	Gas pipe	3,000 lb	.60	.30	.30
7	Concrete pipe, 30" diameter	330 lf	7.00	20.00	15.00
8	Spur connections	8 ea	50.00	150.00	50.00
9	Furnishing pile driving equipment	lump sum	500.00	500.00	1,000.00
10	Piles	9,000 lf	.75	.50	.80
11	Road pavement	2,700 sy	3.25	3.00	3.00
12	Cinders	200 cy	3.00	4.00	2.00
13	Timber guard rail	1,000 lf	1.50	1.50	2.00
14	Electric conduit, 3" diameter	500 lf	3.00	3.00	5.00
15	Pressure tube conduit, 4" diameter	50 lf	7.00	2.00	5.00
16	Asphalt emulsion	2,500 gal	.30	.25	.25
17	Installation of venturi meter	lump sum	4,500.00	3,293.00	12,000.00

Paving at International Airport, Baltimore, Md.

OWNER: City of Baltimore, Md.; Whitman, Requardt-Greiner Co. and Associates, Baltimore, consulting engineers.

PROJECT: Paving and drainage at Friendship International Airport, Anne Arundel County, near Baltimore, Md. Work includes 21,000 ft. of paving three runways designed for 150,000 lb. wheel load. Excavation alone totals 401,150 cu. yds. Drainage includes laying 46,200 lin. ft. of pipe, ranging from 18 in. to 48 in. in diameter.

CONDITIONS: Owner will furnish sand and gravel on site (central plant mixed). Access to job site is available by highway and Pennsylvania Railroad. Contract time is 365 days. Stipulated minimum labor wage rates per hr. are: carpenters, $1.95; plumbers, $2.00; bricklayers, $2.25; cement finishers, $1.90; truck drivers, dump, $1.15 to $1.40; and concrete laborers, $1.10.

BIDS: Three bids were received, ranging from the contract low of $3,243,729.35 to $4,446,455.65. Contract was awarded March 10, 1948.

LIST OF BIDDERS:

1. Langenfelder & Son, Baltimore, Md. (contract) $3,243,729.35
2. Nello L. Teer, Durham, N. C. 3,420,939.40
3. B. Perini & Sons, Inc., Framingham, Mass. 4,446,455.65

	Item	Quantity	Unit Prices Engineer's Estimate	(1)	(2)
1	Clearing and grubbing	130 ac	$750.00	$200.00	$350.00
2	Class I excavation	305,000 cy	0.50	0.35	0.50
3	Class II excavation	85,500 cy	2.25	1.17	1.50
4	Class III excavation	10,650 cy	3.00	.60	0.50
5	Earth shoulders	658,200 sy	0.03	0.055	0.05
6	Gravel-refill	390 cy	4.00	6.11	3.00
7	Tile underdrains	6,200 lf	1.10	0.50	0.65
8	Supercompaction of subgrade	1,269,000 sy	0.034	0.03	0.03
9	Sheepsfoot compaction	1,269,000 sy	0.01	0.0625	0.015
10	Bituminous binder	58,310 ton	6.60	6.35	6.05
11	Bitaminous surface	57,280 ton	6.85	6.10	6.25
12	Tack coat material	68,800 gal	0.1525	0.12	0.15
13	Bituminous mat'l. for seal coat	151,360 gal	0.1525	0.12	0.14
14	Aggregate for seal coat	3,440 ton	8.00	8.50	11.00
15	Waterbound macadam for roadways	16,440 sy	2.10	1.65	2.00
16	Bit. binder course for roadways	1,390 ton	6.60	6.35	6.05
17	Bit. surface course for roadways	1,370 ton	6.85	6.10	6.25
18	Removal of existing pavement	550 sy	1.50	1.00	1.00
19	Concrete (3500 p.s.i)	2,700 cy	50.00	55.50	65.00
20	Concrete (2500 p.s.i.)	500 cy	22.00	44.40	65.00
21	Reinforcing steel	233,460 lb	0.11	0.1138	0.10
22	Soil cement mixture	2,000 cy	8.00	11.60	10.50
23	Steel duct lines—4"	15,200 lf	1.45	1.84	1.70
24	Fiber or cement-asbestos duct lines—4"	28,200 lf	0.30	0.43	0.40
25	Concrete curb and gutter	5,900 lf	1.50	2.75	2.50
26	R.c.c.p.—18"	17,650 lf	3.70	3.06	2.90
27	R.c.c.p.—21"	5,700 lf	4.40	3.97	6.35
28	R.c.c.p.x.—24"	4,000 lf	6.00	4.78	4.35
29	R.c.c.p.x.—27"	5,950 lf	7.00	5.95	5.65
30	R.c.c.p.x.—30"	3,050 lf	8.00	6.86	6.70
31	R.c.c.p.x.—33"	950 lf	9.00	7.97	8.00
32	R.c.c.p.x.—36"	2,250 lf	11.00	8.60	8.70
33	R.c.c.p.x.—42"	100 lf	13.00	11.24	10.10
34	R.c.c.p.x.—48"	250 lf	17.00	12.85	14.35
35	C.m. pipe—15"	5,100 lf	2.50	10.16	3.60
36	C.m. pipe—18"	1,200 lf	3.00	10.55	3.50
37	End sections	102 ea	70.00	94.35	85.00
38	Subdrains	18,200 lf	1.75	0.75	1.00
39	Cast iron pipe—8"	2,750 lf	4.00	7.20	4.25
40	Cast iron pipe—12"	2,750 lf	5.00	10.42	6.95
41	Manholes	775 vf	30.00	38.30	19.50
42	Junction boxes, brick bends, types A, AA, and B, and special brick inlets	56 ea	250.00	499.50	200.00
43	Lining of existing inlets	32 ea	50.00	111.00	50.00
44	Type 'M' inlet frames and gratings	271 ea	75.00	47.73	70.00
45	Type 'N' inlet frames and gratings	19 ea	150.00	83.25	130.00
46	Type 'PA' inlet frames and gratings	5 ea	60.00	55.50	90.00
47	Cont. type inlet frames and gratings	766 lf	18.50	14.43	22.00
48	Sidewalk MH frames and covers	15 ea	25.00	27.75	40.00
49	Standard MH frames and covers	107 ea	35.00	41.07	53.00
50	Manhole steps	650 ea	0.90	1.22	4.00
51	Tie-down anchor rods	60 ea	3.00	31.91	14.00
52	Riprap	500 sy	3.50	9.44	6.00
53	Seeding, mulching, and top-soiling	300 ac	500.00	425.00	500.00
54	Seeding, mulching undisturbed areas	50 ac	400.00	200.00	150.00
55	Sodding	3,900 sy	5.00	0.75	1.30
56	Furnishing and installing compass compensator	1 ea	150.00	1,000.00	900.00
57	Furnishing and laying galvanized steel pipe—4"	3,800 lf	1.45	2.70	2.00
58	Furnishing and installing ground cable	3,000 lf	0.10	0.26	0.30
59	Furnishing and laying cast iron soil pipe—4"	3,250 lf	1.00	2.92	1.30
60a	Sand-bituminous base course (central plant mixed)	250,450 ton	4.95	4.00	4.50
60b	Selected material base course	240,625 cy	1.13	0.70	0.92

Sewerage and Waterworks Additions, Hamburg, Pa.

OWNER: Department of Property and Supplies, Harrisburg, Pa.

PROJECT: Sewage treatment and water filter plants additions at Tuberculosis Sanitarium No. 3, Hamburg, Pa. Work includes complete installation of alum house, 14'3" x 10'11" x 8', enlargement of 9'x11' filter wash house tank; installation of concrete covers for (1) circular clean well, 19'2" dia. and (2) square clean well, 19'2" x 11'2"; construction of pipe bridge, 12' long, over mill creek; sludge beds; glass enclosure, 25' x 25' x 5'6"; resettling basin 20' x 8' x 2'4"; and an imhoff tank, 24' deep, 12' inside diameter.

CONDITIONS: All materials are to be furnished by contractor. Access to job site is available by both rail and highway. Stipulated contract time is 180 calendar days. Stipulated wage rates per hr. are: skilled labor, $1.75; semi-skilled labor, $1.40; and common labor, $1.10.

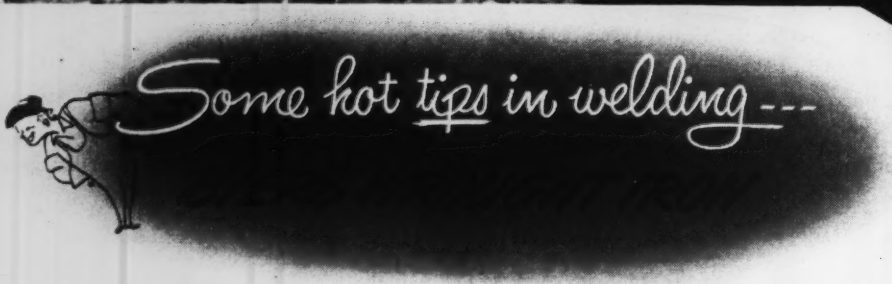
Base bids on this project were submitted in one lump sum without tabulation. Since the additional work on which unit bids were submitted is subject to several alternate plans, there are no definite quantities measurable.

BIDS: Four bids were received, ranging from the contract low of $66,455.00 to $90,390.00. Contract was awarded March 8, 1948.

LIST OF BIDDERS:

1. Robert E. Lamb & Son, Phila., Pa. (contract) $66,455.00
2. Hadley Contr. & Const. Co., Phila., Pa. 76,560.00
3. Wark & Co., Phila., Pa. 89,280.00
4. Harry Gill Co., Phila., Pa. 90,390.00

	Item	Unit Prices (1)	(2)	(3)
1	Trench earth excavation, per cu. yd.	$4.75	$10.00	$8.50
2	Bulk earth excavation, per cu. yd.	3.75	8.00	6.50
3	Earth embankment, per cu. yd.	2.50	4.00	2.25
4	Cast iron frames and covers, per lb.	.20	.20	.30
5	Class A concrete, except form work	18.00	20.00	19.00
6	Form work, sq. ft. contact surface	1.25	1.00	.90
7	Reinforcing steel	.10	.12	.1025
8	Rock excavation, per cu. yd.	15.00	42.00	30.00
9	Furnishing and laying 6" terra cotta pipe, per lin. ft.	5.00	1.45	1.25
10	Furnishing and laying 6" cast iron pipe, per lin. ft.	6.00	5.80	3.00
11	Furnishing and laying 8" cast iron pipe, per lin. ft.	7.50	9.00	4.00



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All that is necessary is to follow ordinary good welding practice, with small modifications to fit the individual, two-component nature of wrought iron. The melting of the *slag* should not be mistaken for the fusion of the *base metal;* heating should be continued until the iron fuses. Only the minimum of parent metal required for a sound weld should be fused. Welding should proceed slowly enough to allow slag to float out of the weld. Unnecessary rubbing or agitation of the molten metal should be avoided.

OXY-ACETYLENE WELDING. In Oxy-acetylene welding, almost any high-quality, low-carbon rod can be used. A neutral flame will give the best results.

METALLIC ARC WELDING. Here coated rods are generally preferable. The large number of special-purpose rods make it difficult to give any general recommendations, but our Engineering Service Department will be glad to suggest suitable types, if you will specify the nature of your needs.

WELDING FITTINGS. A number of well-known manufacturers offer wrought iron welding fittings in a complete range of sizes.

Our bulletin, "The Welding and Flame Cutting of Wrought Iron," gives detailed information on all phases of wrought iron welding. If you would like copies for yourself, or for individuals in your shop, just write.

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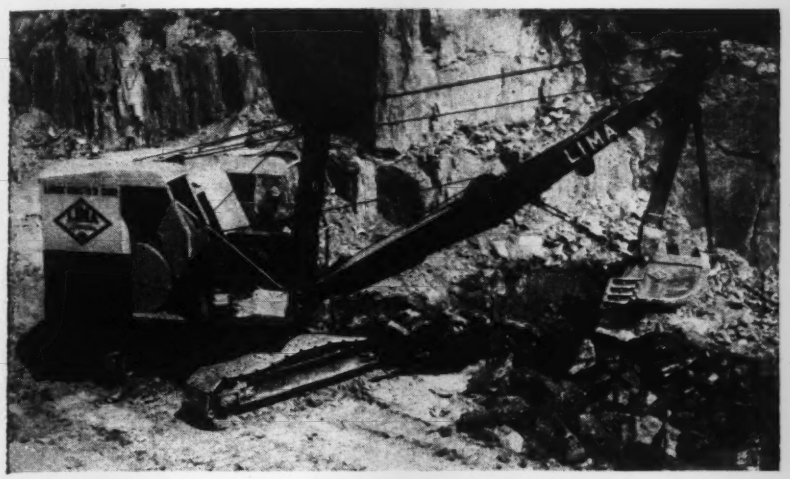
New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

(Number refers to item directly below it)

275



PULL SHOVEL—Here is the new Lima type 34 Paymaster pull shovel equipped with an 18-ft. boom and an 8-ft., 7-in. arm, and a ¾ cu. yd. bucket. The picture shows the shovel in operation on difficult work recently performed on the Bronx River Parkway project in New York City.—*Lima Shovel and Crane Division, Lima-Hamilton Corp., Lima, Ohio.*

276

CAULKING GUN—A newly-invented caulking gun is of globular construction which permits the introduction of an elastic diaphragm. The gun has such special advantages as these: All parts except the nozzle are either of aluminum or magnesium making for light weight; there are no air leaks and no nozzle drip; and all contact of air with caulking material in the gun is eliminated, keeping it moist and usable longer. The gun weighs only 6½ lb. and has a capacity of 3¼ pints.—*Pedrick Tool & Machine Co., 3,640 N. Lawrence Street, Philadelphia 40, Pa.*

277

ALL-PURPOSE TOOL KIT—Designed for construction men, compact and portable tool kit, has equipment for drilling of steel, masonry and wood, nut and bolt running and removal and screw driving and removal, all with a single unit, the Ingersoll-Rand electric impact tool. By using standard accessories, tool perform a multitude of jobs easily and quickly. Tool plugs into any ac-dc electric socket and runs as any conventional electric tool until the going gets tough; then the impact mechanism automatically functions and delivers 1900 rotary impacts per minute. Available with either 110 volt or 220 volt motors as required.—*Ingersoll-Rand Co., Phillipsburgh, N. J.*

278

TAMPING ROLLER—New Gebhard Model 1TO is designed to give maximum compaction of earth for dams, airports and railroad fills. Equipment has special wedge-shaped feet, hard-surfaced for long life. Each foot has a bearing pressure of 590 lb. per sq.in. Roller comes in one or two-drum units. A double unit is attached to a central draw shaft with heavy steel hinges. Each drum acts independently over terrain irregularities.—*Shovel Supply Co., Dallas, Tex.*

279

FLOOR TAPE APPLICATOR—A new machine quickly joins sheets of asphalt-impregnated paper into a single protective covering for fresh concrete. The machine, weighing 33 lb., presses a tape tightly in place, securely bonding the paper blankets together, according to the manufacturer, who makes both the tape and the applicator. When the concrete has cured, the tape can be stripped off easily, permitting the full width of the protective paper to be re-used repeatedly.—*Minnesota Mining and Manufacturing Co., 900 Fauquier Ave., St. Paul 6, Minn.*

280

RUNWAY BEAMS AND SPLASHBOARDS—A runway beam provides a simple and efficient way to erect scaffold beams in constructing runways from which concrete is poured into the foundation forms made up of Symons standard panel forms or their equivalent.

IF YOU WANT MORE INFORMATION on new products or manufacturers' publications, mark the identifying item numbers on the coupon below, and mail. No cost or obligation to you.

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POWDER OPERATED CONSTRUCTION TOOL

Drives Threaded Studs 3 Inches into Concrete INSTANTLY!

Several of the 30 threaded and unthreaded studs available with the DRIVE-IT tool.

Stud Holding Power Between 2000 and 6000 Lbs.

.38 Cal. (top) and .22 Cal. (bottom) DRIVE-IT TOOLS

"YOU won't believe it until you see it operate," is the almost unanimous opinion of contractors who have adopted the amazing new Powder-Power tool, DRIVE-IT, to drive steel studs through wood or metal into concrete.

HOW IT WORKS

The DRIVE-IT tool employs a small powder charge encased in a standard cartridge to drive studs 3" into concrete and through 5/8" steel. The desired stud and cartridge are placed in the tool. The muzzle of the tool is placed on the spot where the stud is to be driven and the tool is forced forward. This detonates the explosive charge, driving the stud into concrete or steel with such force the stud actually fuses with aggragate or metal. Up to 6000 lbs. force is required to pull DRIVE-IT studs from ordinary concrete.

UNLIMITED APPLICATION

The DRIVE-IT tool offers unlimited application for all contractors:

ELECTRICAL: For anchoring conduits, switch boxes, cables, etc., to concrete and masonry.

PLUMBING AND HEATING: For hanging pipe, heating ducts, from concrete ceilings or walls.

PLASTERING: For suspending ceilings or "nailing" wood firring to concrete.

GENERAL: "Nailing" steel window and door frames, wood sleepers, etc., to concrete.

ABSOLUTELY SAFE

DRIVE-IT, the **original** powder-operated tool, functions without recoil shock. It is **absolutely safe** and cannot be discharged even if dropped several floors.

Write for Demonstration

The DRIVE-IT distributor in your region will be glad to show you the .38 cal. and .22 cal. models in operation. Write for complete DRIVE-IT information, name and address of your nearest distributor.

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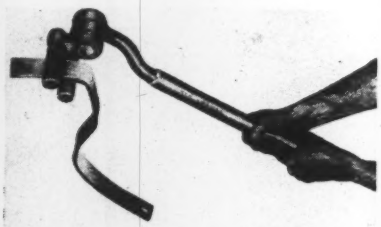
FOOT OF S.W. WOODS STREET (DEPT. D)
PORTLAND 1, OREGON

The runway beam, an oversize 4x4, is fastened to the form by a large steel hook which fits over the top of a standard panel and is secured to the end of the beam with heavy gauge steel hardware bolts. The outer end of the beam has a U-shaped clamp, with slotted sides, which extends out beyond the beam about 3¼ in. The clamp is placed over a vertical 2x4 beam which butts against the horizontal beam. To secure the two beams a steel wedge is placed through the slotted sides of the clamp and is drawn tight against the vertical by a hammer flow. The company also makes a splashboard 4 ft long, 1 ft. deep and 2 in. thick, with steel prongs on both ends.—*Symons Clamp and Mfg. Co., 4265 Diversey Ave., Chicago 39, Ill.*

281



BENDING BAR FOR REINFORCING—This tool has two adjustable arms which can be placed close together or far apart, and they can be positioned on the hexigon post so that the handle will project at the desired angle. More than 100 different positions of the arms are possible for bending, straightening, aligning, spreading and forming various parts and materials.—*Plomb Tool Co., Los Angeles 54, Calif.*

282

PLASTIC CEMENT FOR TANKS—A new type of plastic cement is said to be a permanent cure for leaks in large or small tanks, or in fuel tanks on cars, trucks or tractors. It can be applied without removing the liquid from the tank. The method is to place a small piece of ordinary screen wire over the hole and then fill the wire with plastic. The preparation is not affected by heat or cold, and it adheres to any type of metal, glass or wood.—*The Phillips Plastic Co., Newkirk, Okla.*

283

TWO WHEEL TRAILER COMPRESSOR—Air Chief Model 160 is 4-cylinder V-type compressor with capacity of 160 c.f.m. Perfect chassis balancing provides handling ease. New trailer compressor unit is 153 in. long, 72 in. wide and 66 in. high; it weighs 4300 lb.—*Davey Compressor Co., Kent, Ohio.*

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. . . says PAUL J. FREDERICK,
Indiana Construction Man

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PAUL J. FREDERICK

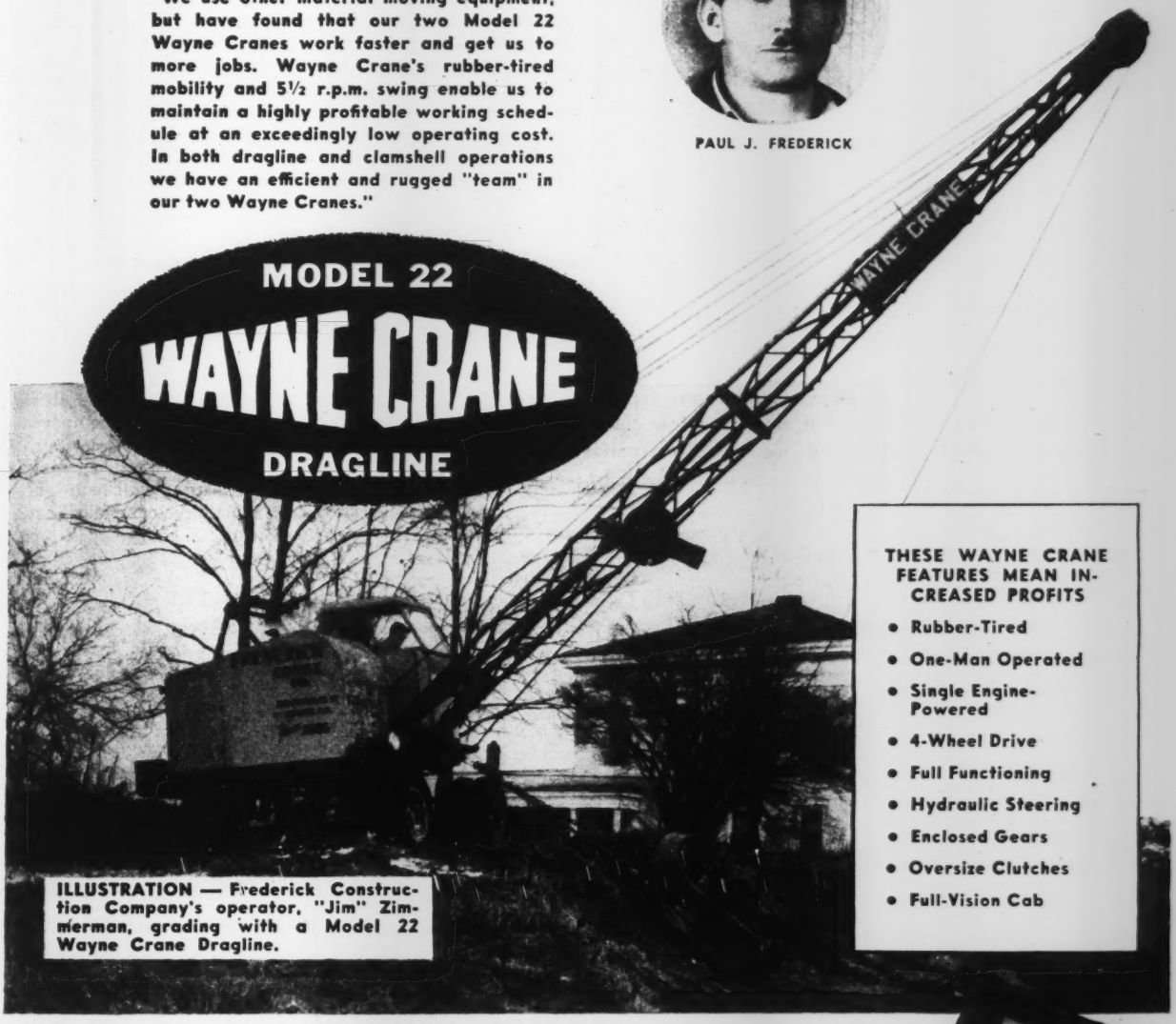

ILLUSTRATION — Frederick Construction Company's operator, "Jim" Zimmerman, grading with a Model 22 Wayne Crane Dragline.

THESE WAYNE CRANE FEATURES MEAN INCREASED PROFITS

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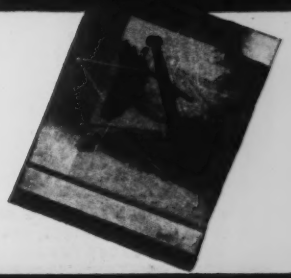

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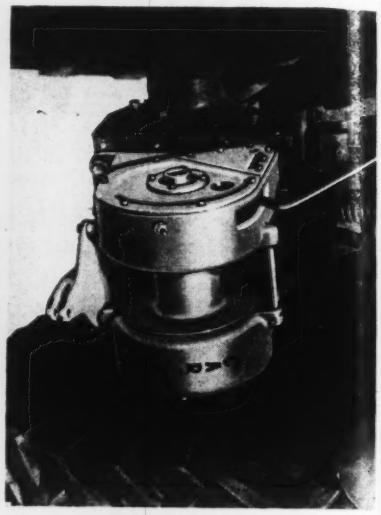
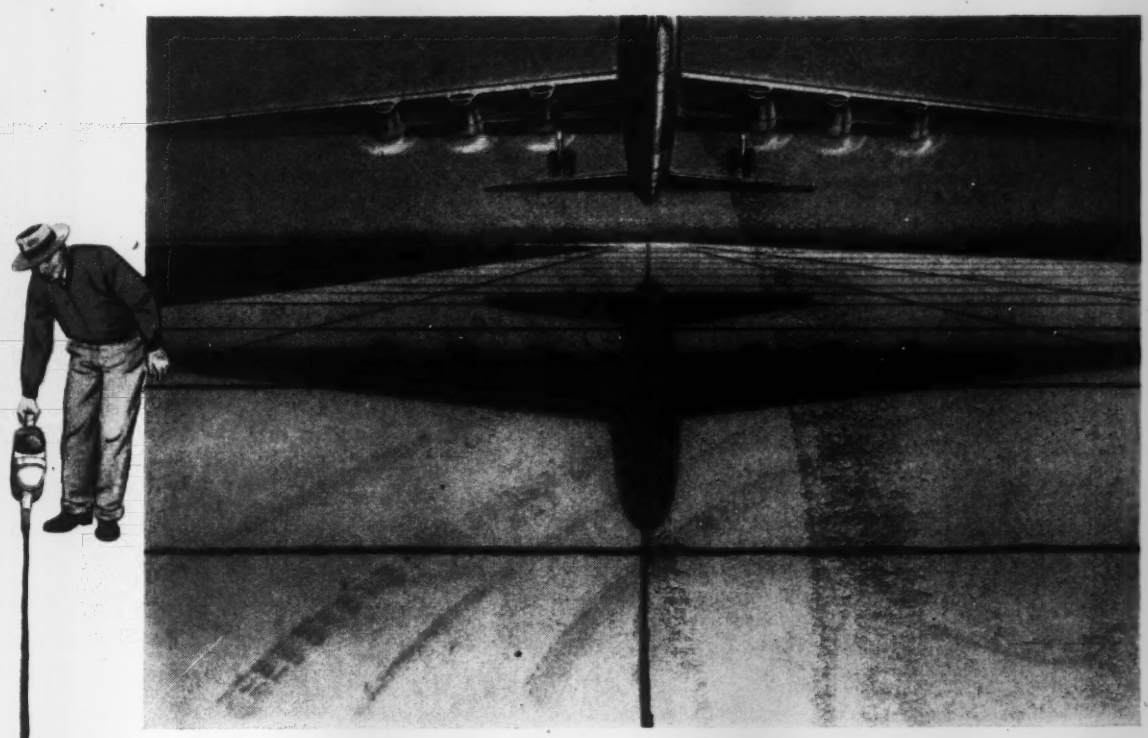
284



WINCH FOR SMALL TRACTORS—The Carco Model S is a winch to fit the smaller range of wheel and crawler tractors. Providing smooth power with a line pull up to 6,500 lb., it is claimed for this winch that it will enable a small tractor to perform many pulling, hoisting and skidding jobs that generally tie up heavier, more expensive equipment. It features automotive-type gears, friction cone clutch, self-energizing brake, ball and roller bearings, oil bath lubrication, and a one-piece carcometal case. —*Pacific Car and Foundry Co., Renton, Wash.*

285

NEW VIBRATING SCREEN—After two years of field testing a new positive eccentric vibrating screen, "Screen-all" has been released for general sale. Eccentric hubs are mounted on a straight shaft. The hubs can be perfectly counterweighted so that there are no offset stresses in the shaft. Together with the positive vibration equalizer which transmits equal vibration to every square inch of all decks, this absence of unbalanced forces during the complete operating cycle eliminates transmission of any vibration to the supporting structure without the use of side or end springs or guy cables. —*Lippman Engineering Works, 4,603 West Mitchell Street, Milwaukee 14, Wis.*



History-making runway sealed with Carey lastic

At Patterson Field, Dayton, Ohio, a 10,000 foot concrete runway was recently completed to handle our nation's biggest bombers. The slab is as much as 25" thick.

Dummy joints were used instead of expansion joints because of the thickness of the slab. These dummy joints and the longitudinal joints between the 25' lanes were sealed with *Careylastic!*

CAREYLASTIC sealing compound, meeting both Federal Specification SS-F-336 and State Highway specifications for top seal, is a mixture of rubbers, asphalts and suitable plasticizers. It retains its plastic and elastic properties at winter and summer temperatures.

CAREYLASTIC is but one of a complete line of highway construction products developed by Carey research. Like all Carey products, they are being checked and tested continually to improve their value and service.

CAREY ELASTITE EXPANSION JOINT is a "sandwich" of heavy-bodied plastic asphalt compound between layers of asphalt saturated felt. A variety of thicknesses and shapes are available. It cuts to size easily.

CAREY ELASTITE FIBRE JOINT is a non-extruding expansion joint made by saturating structural fibre board with an especially prepared durable asphaltic compound.

CAREY SUBGRADE FELT is a tough, strong and lightweight water-resistant felt for use over earth subgrade when it is used as a base for concrete. It eliminates absorption by the subgrade as a variable, increases both strength and uniformity of concrete.

CAREY FILLER ASPHALTS are crack sealing and joint filling asphalts used in maintenance work on existing pavements and construction.

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Pipe Line Felt

write for your copy of Carey "Elastite products—for ...crete and masonry construction". Address Dept. EN 4.

I'M YOUR MAN

FOR THE *FASTEST* WAY TO LAY PIPE... WITH *MINIMUM* LABOR COSTS!

ON "VIC VICTAULIC" at the right you can *see* the two-bolt simplicity of Victaulic Couplings that saves valuable man-hours and labor costs on installation of *any* piping system! Just a few turns of a standard T-wrench buttons up the two half-housings of Victaulic Couplings ...with no specially trained or skilled labor needed!

ALSO, THESE FEATURES are built into every Victaulic-coupled piping system: *flexibility* that automatically allows for contraction or expansion, lessens need for expensive bends and fittings...*a union at every joint* for easier, quicker repairs or salvage...*positive-locked* joints that can't pull out or blow off!

WHAT'S MORE, Full-Flow Victaulic Elbows, Tees and other FITTINGS increase pipe-line delivery *at lower pumping costs!*

REMEMBER, TOO—the new "Vic-Groover" grooves pipe ends with half the effort *and twice as fast* as ordinary pipe threaders!

WRITE TODAY for Victaulic Catalog and Engineering Manual No. 44...and for the new "Vic-Groover" Catalog No. VG-47.

SELF-ALIGNING PIPE COUPLINGS

VICTAULIC

EFFICIENT FULL-FLOW FITTINGS SIZES—3/4" THROUGH 60"

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Victaulic, Inc., 727 W. 7th St., Los Angeles 14, Calif.

Victaulic Company of Canada, Ltd., 200 Bay St., Toronto 1

For export outside U. S. and Canada: PIPECO Couplings and Fittings:

Pipe Couplings, Inc., 30 Rockefeller Plaza, New York 20, N. Y.

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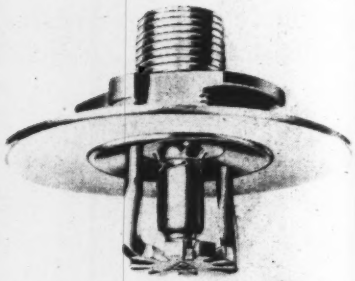
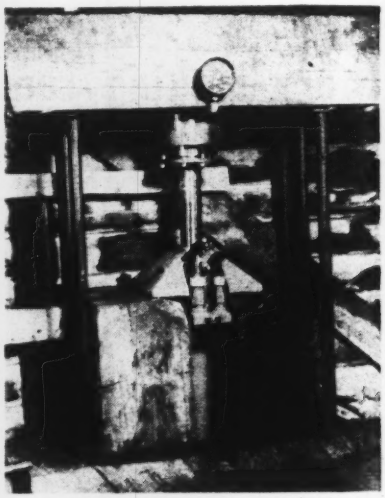
286



ATTRACTIVE CEILING SPRINKLER—The new Grinnell quarzoid ceiling sprinkler fed by concealed piping can be used without detracting from artistic decoration. Nothing but the deflector supported by its arms and the attracive bulb show below the smooth level of the ceiling. Temperature at the ceiling over a starting fire has to reach only 135° F to burst the bulb and release the water. — *Grinnell Co., Inc., Providence, R. I.*

287

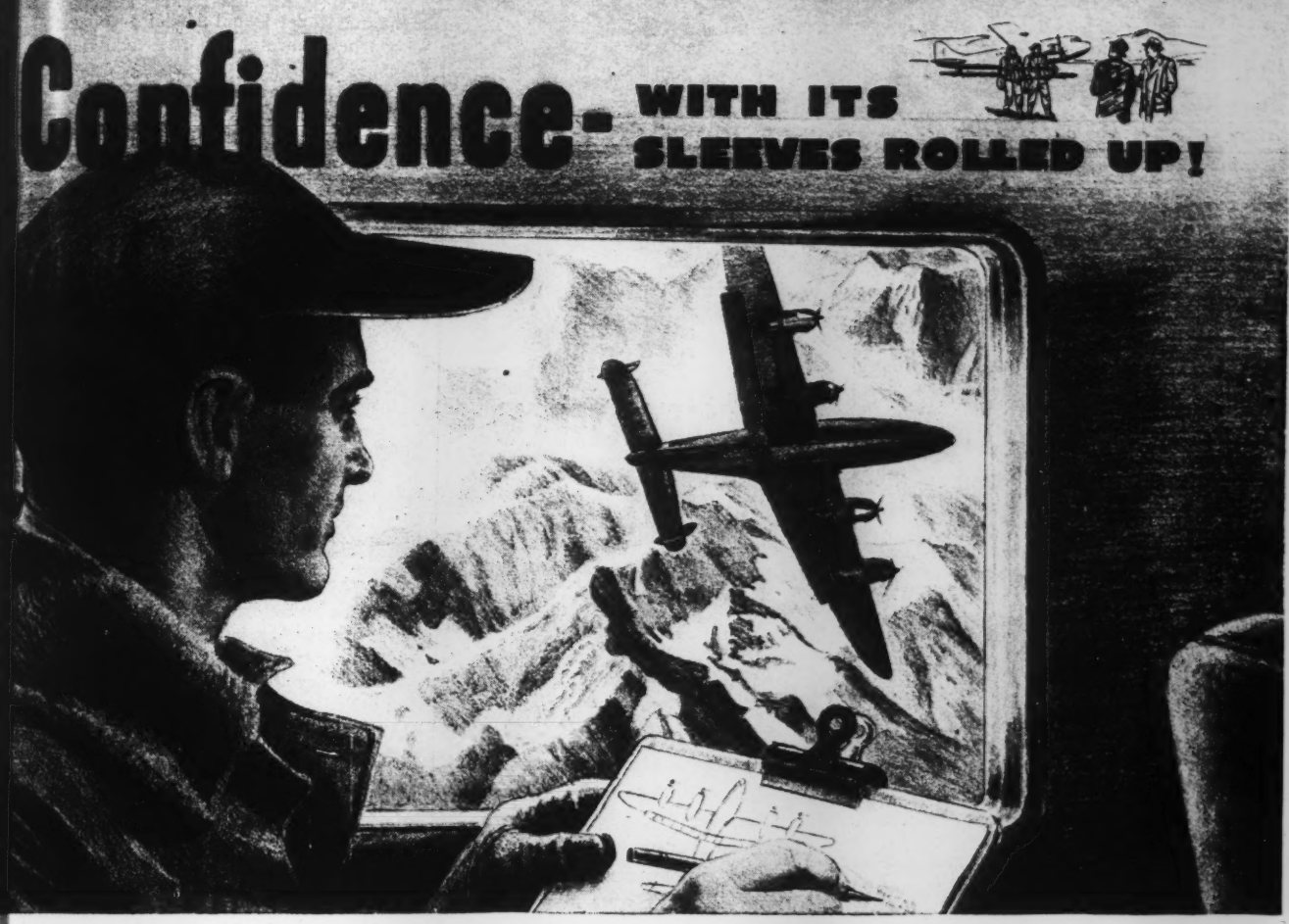


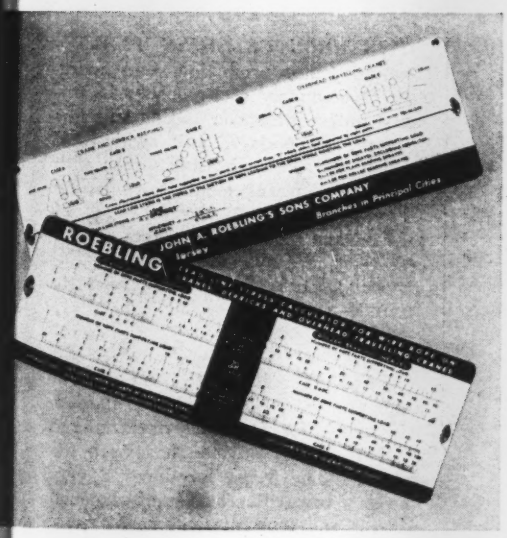
HYDRAULIC JACK—This new hydraulic jack in 12- and 25-ton models, with 40-, 75- and 100-ton models forthcoming, has a wide base, shaped like a pyramid, with the hydraulic cylinder extending below the cribbing which supports the jack. In the 25-ton model illustrated, working clearance is only 6¾-in. while lifting range is 16-in. Two oil pressure pumps, operated by a removable steel handle, provide high speed either vertically or horizontally. —*The Curtis Jack Co., Seattle, Wash.*

288

REVOLVING SCOOP — Full-revolving, cable crowded scoop, is designed to clean corners, load gravel, coal, earth, aggregate or snow. Operates from all angles. Available as standard attach-

Confidence- WITH ITS SLEEVES ROLLED UP!





YEAR BY YEAR, planes grow bigger . . . faster and safer. Man has unbounded confidence in his ability to build better and better planes. Never satisfied, he experiments and tests tirelessly, and aviation progresses.

With similar vision and confidence, Roebling has been pacemaker in the development and manufacture of products essential to the transportation and other industries. The active, widespread confidence it has won among technical men and operators throughout industry is Roebling's proudest asset. Look to Roebling for continued leadership . . . continual improvement in its products and engineering . . . continual progress.

WHAT SIZE OF ROPE? HERE'S YOUR ANSWER—FREE

DATA used by Roebling engineers themselves are embodied in this unique "slide rule". It's the Roebling Lead Line Stress Calculator for wire rope . . . tells you in a moment the safe and economical size of rope for every load . . . gives the right answer for all types of crane, derrick, and overhead traveling crane installations.

Here's information you can accept and act upon with complete confidence . . . just as you can specify Roebling "Blue Center" Steel Wire Rope for unsurpassed toughness, dependable reserve strength and the reduction of costly replacement shut-downs. Roebling was America's first wire rope maker, and "Blue Center" Steel Wire Rope is the finest that Roebling knows how to make.

Write for a Roebling Lead Line Stress Calculator — it's free. And let your Roebling Field Man tell you about installation and maintenance practices that prolong wire rope life. Call him at your nearest Roebling branch office.

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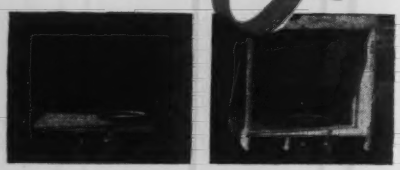
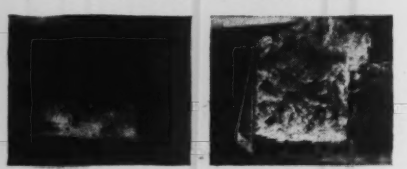
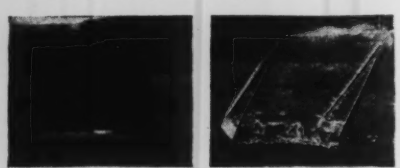
Tests Confirm fire retardance of KOPPERS CZC(FR)



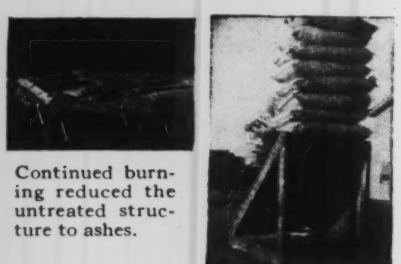
Test structures built of Koppers fire-retardant wood (left) and untreated wood (right) ready for the fire test. Five quarts of kerosene, placed in pans, furnishes fuel for each blaze.



Both structures are quickly enveloped in flame. Treated structure resists fire, but untreated one encourages it, contributes fuel to the fire.



After twenty-two minutes the untreated structure, still burning, is collapsing. Note that in the treated structure, the fire stopped when the fuel burned out.



Continued burning reduced the untreated structure to ashes.

Above right · The treated structure was charred . . . but retained its integrity and strength, as the 800 pound load shows.

Koppers fire-retardant wood is suitable for use as flooring, roofing, sheathing and structural members of industrial buildings, garages, airplane hangars, munitions plants, docks and warehouse buildings, railroad engine houses, and other similar structures. Koppers CZC(FR) treatment has a valuable plus advantage, for it also fortifies the wood against decay and termite attack. Color and paintability are not harmed by the odorless CZC(FR) treatment.

Send for your copy of "Koppers Fire Retardant Wood." Filled with interesting and helpful information.

KOPPERS

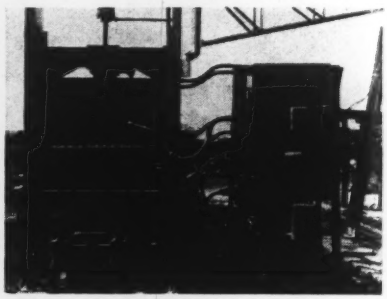
PRESSURE-TREATED WOOD

KOPPERS COMPANY, INC.

PITTSBURGH 19, PA.

ment for Model E and Model J Quic Way truck shovels. Scoop is availab in capacities of 3/8 and 5/8 cu.y Dumping radius is 6 to 16 ft., dumpi height of 3 to 16 ft. 6 in. and diggi radius up to 19 ft. Scoop is int changeable with other attachments. *Quick-Way Truck Shovel Co., Denv 5, Colo.*

289



BLOCK MAKING MACHINE—An automatic concrete block-making machine which may be instantly adjusted to any cycle for variation in mix used has been developed. Frame is raised by the cylinder at the top of machine as a conveyor chain pulls forward one of the stacked pallets. In the next move of the cycle, the loading box fills the molds and starts the vibrator. The blocks are squeezed as the vibration ends, then stripped out and the pallet moves forward. Three of these cycles are completed in one minute, making six blocks a cycle.—*Accurate Tool & Engineering Co., San Diego, Calif.*

290

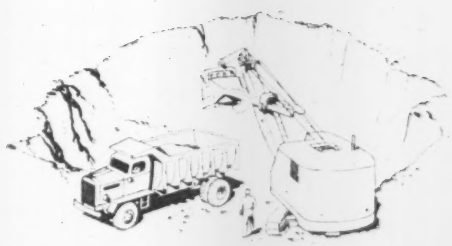
PORTABLE CRUSHING PLANT— Two-unit plant producing road aggregate from quarry rock consists of primary unit with apron feeder and jaw crusher; secondary unit with roll crusher and deck vibrating screen with split feed arrangement to separate screening surfaces. Several sizes of primary and secondary crushers as well as screens are available.—*Pioneer Engineering Works, Inc., Minneapolis* 13, *Minn.*

291

MARKING INSTRUMENT — An automatic valve-controlled pocket fountain brush for marking, drawing and writing on any surface has been developed. The brush produces a very fine or a broad line by use of a special adapter and four interchangeable nibs. —*Cushman and Denison Mfg. Co., 135 W. 23rd St., New York 11, N. Y.*

291A

TANK CAR UNLOADER—Pumping unit for unloading asphalt, oil or other thick materials from tank cars has 4-in. Grace gear-type pump, with built-in



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SINCE 1918 PIONEER OF PROFITABLE POWER THROUGH HIGH SPEED DIESELS

Big Loads... Fast Work Cycles

Power and *more power* . . . the kind you need to move more material . . . the kind that means faster swings and dumps for your shovels . . . quicker trips for your trucks.

This *plus-power* of the Series NH-600 (200 hp, max.) and NHS-600 Supercharged (275 hp, max.) Cummins ***Dependable*** Diesels results in big loads, fast work cycles, more work from your heavy-duty equipment.

Ask your Cummins Dealer to study your power problems with you . . . see why "more power" will mean "more profit" on your job.

CUMMINS ENGINE COMPANY, INC.
COLUMBUS, INDIANA

SPARLING MAIN-LINE METERS

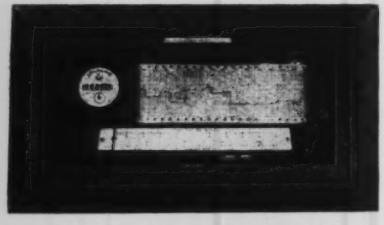
A Money-Saving Suggestion for YOU!

HAVE your men install Sparling Meters on each of your distribution mains. Then you will *know* exactly how much water goes to each section of the city!

Total the service meter readings monthly on each section and compare with the Sparling registers. As long as the two totals agree closely, O.K. If there is an appreciable loss, you have narrowed down the area to be investigated.

Statistics show that losses *per mile* of main may run to 40,000 gallons a day! The first step toward saving your treated water is to meter your main-lines.

If Totalization is all you need, no instrumentation is needed with Sparling Meters. Flow-rate indication and recording are optional.



Quotations gladly given.
Bulletin 310 comes upon request.

R. W. SPARLING
Manufacturers of WATER MEASURING EQUIPMENT

LOS ANGELES 54. . Box 3277 Terminal Annex — 622 Broadway . . . . . CINCINNATI 2
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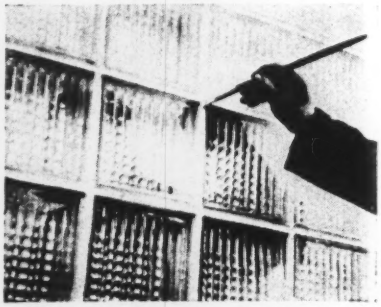
UNIT 357
FOR YARD OR HIGHWAY
LIFT—LOAD—DIG—HAUL
WITH ONE OPERATOR . . . ONE ENGINE
• It's Self-Propelled
• It Rides on Rubber
Write for catalog showing UNIT'S many modern and exclusive features.
UNIT CRANE & SHOVEL CORP.
Milwaukee 14, Wis., U.S.A.

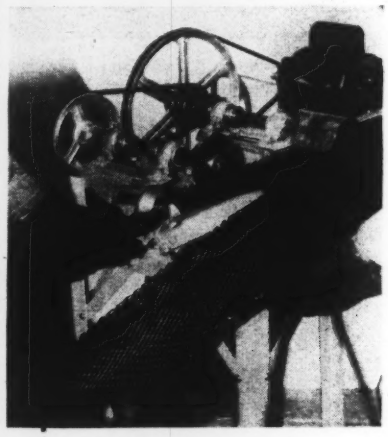
strainer, driven by 20-hp. motor. Trail- or skid-mounted, unit delivers 275 gp at 1,800 rpm. engine speed. Oth pumping rates are obtainable sprocket changes.—*W. E. Grace M Co., Dallas* 15, *Tex.*

292



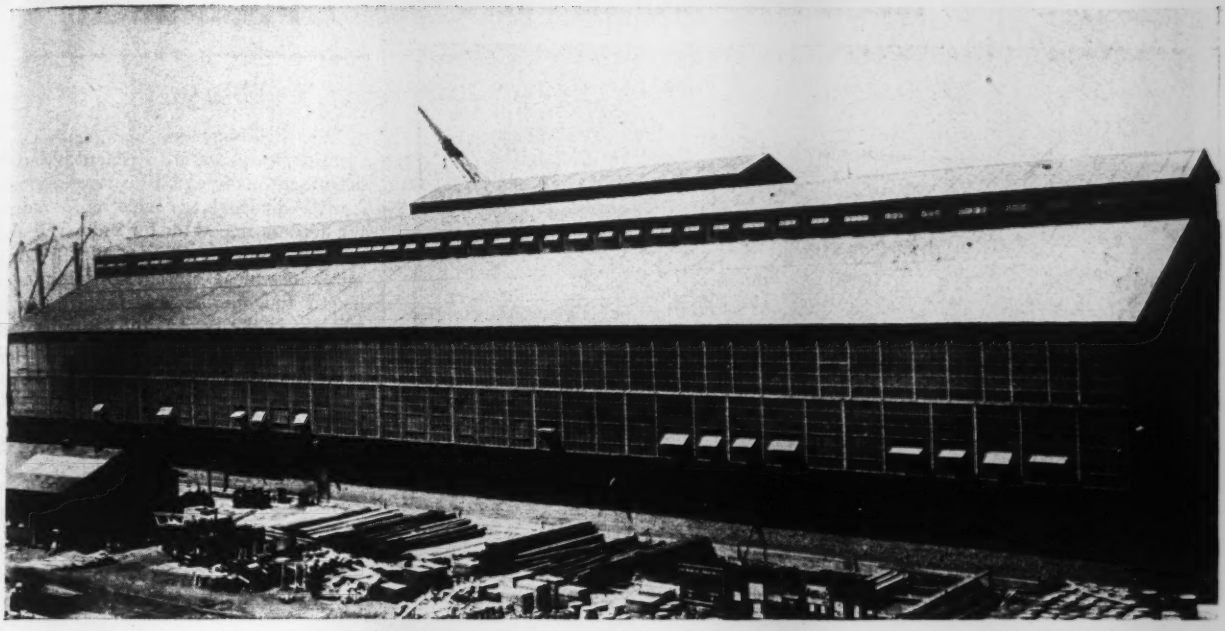
MORTAR SEALANT FOR GLASS BLOCK—New product known as Klee sealant coats exterior mortar joints, adheres to mortar and forms a tight flexible bond. Of plastic-like consistency, it can be applied with calking gun, or thinned with solvents for brushing consistency. Available in white and other colors.—*American Fluresit Co.*, 635 *Rockdale Ave., Cincinnati, Ohio.*

293

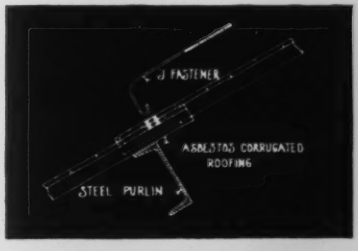


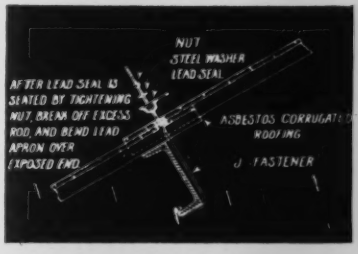
METAL LATH CUTTER—A new special-purpose machine for cutting expanded metal lath into angles for corners has been announced. The machine may be adjusted for width of strip and set for forming angles for plastering ceiling corners and around doors. The manufacturer says the machine has a capacity of 5,760 lin. ft. of corner-rite per hour on this type of work. One operator and helper are required for this production. The machine consists of a guide rail, guide angle, cap screw for opening or closing formed angle in material, a follower roller and three collars for setting form roll. It is with or without motor and table.—*Scritchfield Mfg. Co.*, 1905 *Pacific Highway, San Diego, Calif.*

K&M "Century" ASBESTOS CORRUGATED



Details of one of the new TOP-SIDE Fasteners exclusive with K&M "Century" Asbestos Corrugated for roof installations.




NUT
STEEL WASHER
LEAD SEAL
AFTER LEAD SEAL IS SEATED BY TIGHTENING NUT, BREAK OFF EXCESS ROD, AND BEND LEAD APRON OVER EXPOSED END
ASBESTOS CORRUGATED ROOFING
J FASTENER

RESISTS CORROSION
right on the water front

The roof of this huge ship-building plant has to take a tough beating from the corrosive atmosphere of the river front. Thus it was natural that K&M "Century" Asbestos Corrugated should have been specified as the roofing material . . . for this durable asbestos-cement product is inherently immune to corrosion.

Of course, resistance to corrosion is but one of "Century" Corrugated's good points. It is completely fire-resistant. It won't rot . . . nor is it affected by the elements. Time only toughens it . . . no painting or other upkeep is needed.

The new TOP-SIDE Fasteners, available *only* with K&M "Century" Asbestos Corrugated, cut erection costs on roof installations over steel purlin construction. That's because TOP-SIDE fasteners can be applied wholly from the roof surface . . . thus eliminating the need for costly scaffolding beneath the roof.

If you are planning any remodeling or new construction, it will pay you to look further into the advantages of "Century" Corrugated. Write for full details.

DIAMOND ANNIVERSARY 1873 1948 K&M KEASBEY & MATTISON CO.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873.

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here is beauty

that is more than skin deep

here is the beauty of fine design and excellent craftsmanship which assure true ownership economy.

on the construction job, particularly, a good gas welding and flame cutting outfit is a necessity. on a construction job, however, such an outfit is used largely for emergency repair, for hard facing, for silver brazing and for flame cutting—such an outfit, therefore, must be dependable . . . on the job when needed. and—that quality is one of the numerous reasons why victor welding and cutting equipment is today the most popular and one of the most highly regarded in industry.

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Manufacturers' Publications

294

Floc Producer—A new method of forming floc in water treatment plants is described in 4-page illustrated folder. For "Alhydro," the electronic means for flocculating water for industrial and potable use, it is claimed that it minimizes chemical storage, is simple to install and operate, and is particularly efficient in the removal of turbidity and color. The principle involved in the method is electrolytic dissolution of aluminum in water to form a concentrated aluminum hydroxide floc.—*Alhydro, Inc.*, 516 *North Charter Street, Baltimore* 1, *Md.*

295

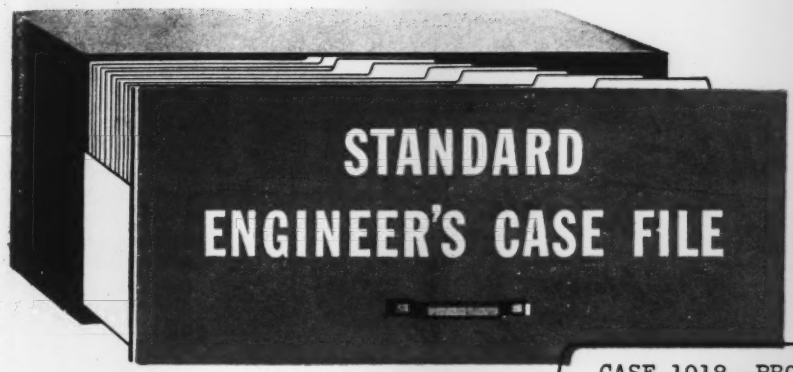
Pneumatic Sewage Ejector—Chief advantages of the Shone ejectors are listed in a 20-page catalog as follows: No screens, shredders, impellers, wet well, sewer gas, or complicated piping. Neither is there danger of explosion; sewage can not get into compressors; ejector can be operated under water and from distant compressor; and no sedimentation in receiver. The ejector consists of a closed sewage receiver or pot with check valves on inlet and discharge, and a pilot slide valve mounted on the receiver head and actuated by two open bells suspended in the receiver.—*Yeomans Brothers Co.*, 1433 *North Dayton Street, Chicago* 22, *Ill.*

296

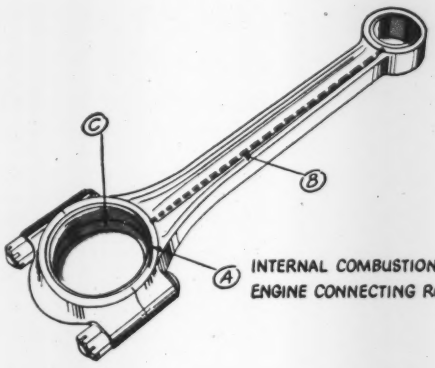
Automatic Sprinklers—A new 26-page illustrated booklet describing the design and application of contemporary fire protection for extra hazardous areas in industrial plants where highly inflammable liquids and solids are involved. This method employs an automatic fire-fog system of applying water spray for fire protection. Several illustrations show the component parts and installation details of the automatic system.—*Automatic Sprinkler Corporation of America, Youngstown, Ohio.*

297

Cord-saver Extension — Bulletin describes a new cord-saver extension reel called Port-O-Reel, a completely portable unit weighing less than 15 lb. without cord. it is designed to save time and cord and to speed work on any application requiring extension cords. This new unit prevents kinks and simple knots by means of a cord-guide which level-winds the cord as it is



CASE 1018--PROLONGING BEARING LIFE IN HEAVY-DUTY ENGINES.



INTERNAL COMBUSTION ENGINE CONNECTING ROD

In toughest operating conditions, specially compounded RPM Heavy Duty Motor Oil maintains lubricating film on bearings. For both gasoline and Diesel engines. Comes in five grades: SAE 10 to SAE 50.

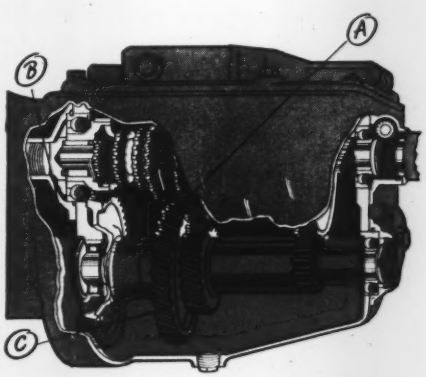
A. Contains anti-corrosion compound. Won't pit or honeycomb copper-lead, cadmium-silver or any other bearing metals.

B. Detergent keeps all oil passages and parts clean. Assures adequate supply of oil to all bearings, prevents ring-sticking and slow action of parts.

C. Adherence to metal surfaces, whether hot or cold, minimizes both running and starting wear. Film stays on idle parts and protects against rusting.

Other compounds in RPM Heavy Duty Motor Oil and natural qualities of selected base oils resist oxidation, formation of sludge and prevent foaming.

CASE 1029--REDUCING WEAR IN CONVENTIONAL AND WORM GEARS.



TYPICAL AUTOMOTIVE TRANSMISSION

Compounded RPM Gear Lubricant satisfactorily met all operating conditions in these gears in cars, trucks and similar machines. Comes in four grades: SAE 80, 90, 140 and 250. (For hypoids, use RPM Multi-Service Gear Lubricant.)

A. Compounds help resist high temperatures and pressures on gears. Minimize deposits and thickening. Make it non-corrosive to metals in gears and cases.

B. No foaming and leaking trouble - contains most effective foam inhibitor known.

C. High affinity for metal maintains lubricating film at all times. Constant oil wedge at gear contact points prevents scoring and extra wear.

RPM Gear Lubricant (Compounded) resists viscosity changes ... allows easy shifting in low temperatures and fast flow of lubricant onto gears.

For additional information and the name of your nearest Distributor, write

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The California Oil Company
30 Rockefeller Plaza, New York 20, N. Y.

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Standard Oil Company of Texas
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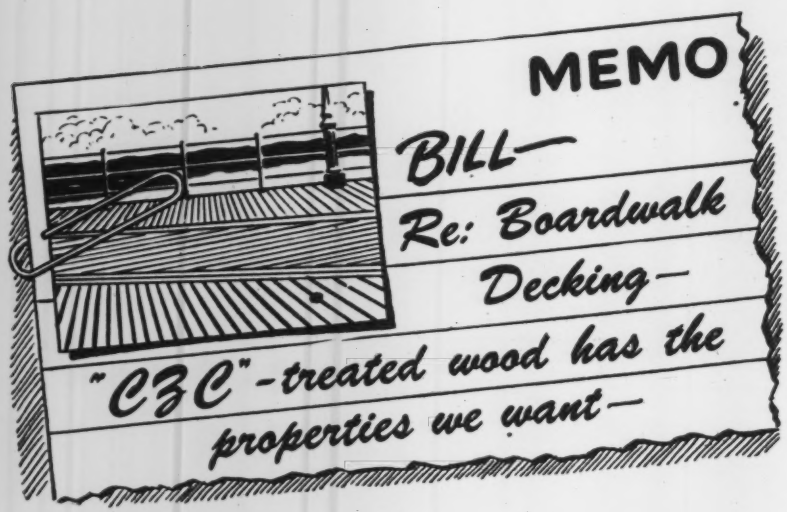
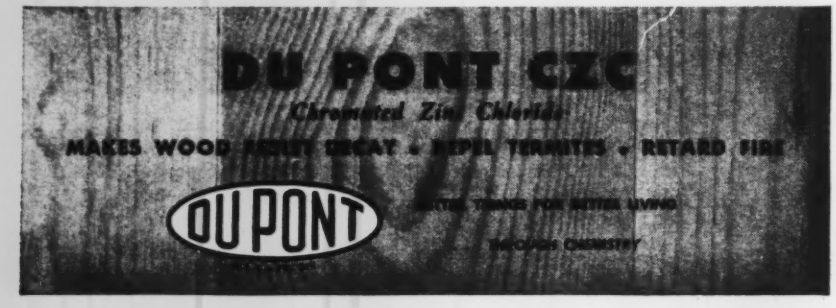


RESISTS DECAY: Boardwalk decking, caps and stringers are highly susceptible to decay—but wood that has been treated with Du Pont Chromated Zinc Chloride resists this costly damage—repairs and replacements are reduced wherever "CZC"-treated wood is used.

RETARDS FIRE: No chance for matches and cigarettes to cause fire in boardwalk decking built with "CZC"-treated wood. "CZC" gives wood greater protection against fire.

IMPROVES SAFETY: No danger of decking giving way because of decay, termites, or fire. "CZC"-treated wood resists these destructive forces—stays in better condition for a longer time.

Find out how "CZC"-treated wood can give your boardwalk deckings additional life. Write today for more detailed information. E. I. du Pont de Nemours & Co. (Inc.), Grasselli Chemicals Dept., Wilmington 98, Del.



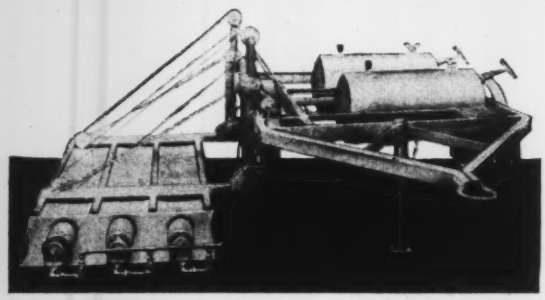
White SURFACE HEATERS

Why destroy pavement base to apply new surface?

These heaters melt 1" of old asphalt in 5 minutes. New top can be placed without damage to base.

Sizes: 6x6'; 3x6'.

Write for Catalog



Elkhart White Mfg. Co. Indiana

re-wound on the reel. A substantial base and the low set of the cord-guide prevents tipping and a specially designed, ball-bearing swivel provides automatic alignment of the reel and cord with the operator as the cord is drawn from the reel. All units are equipped with a rubber ring on bottom edge of base to prevent scratching of floor surfaces and to prevent slipping.—*Industrial Electrical Works, Omaha, Neb.*

298

Brick Engineered Homes—A plan book contains floor plans and elevations for 6 newly-designed homes of masonry construction, part of the industry-engineered housing program by brick and tile manufacturers. It is claimed for the system that it reduces costly material waste and time-consuming fitting operations. For each of the designs in the booklet working drawings have been developed by an architect skilled in application of modular coordination to small home design.—*Structural Clay Products Institute, 1750 K Street, N.W., Washington 6, D. C.*

299

Utility Pumps — A circular gives facts on a new self-priming centrifugal pump especially built for utility company service. It is claimed that priming is automatic on suction lifts up to 25 ft. high. They are misers on fuel. —*Marlow Pumps, Ridgewood, N. J.*

300

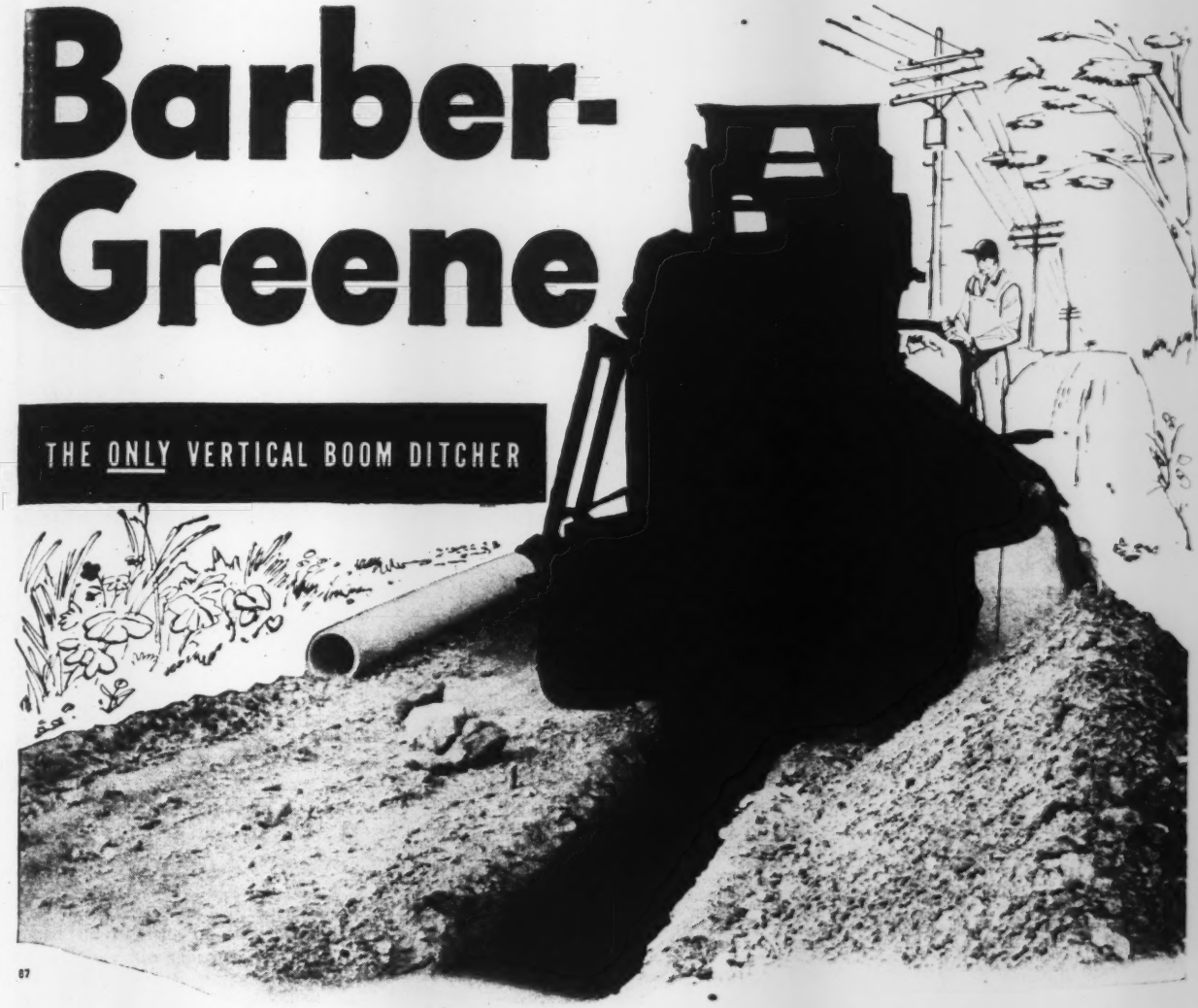
Gas Safety Equipment—A 12-page booklet on the prevention of sludge gas explosions in sewage treatment plants includes data on flame traps, pressure relief with waste gas flame trap, waste gas burners, pilot line valves, and manually-operated drip trap and accumulator for condensate and sediment. Typical gas piping arrangements for single and multiple digester installations are also shown in drawings.—*Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago 13, Ill.*

301

Chemical Feeders—A bulletin explains the purposes and applications of the different control systems for feeding chemicals to raw water to correct or eliminate impurities, and describes the various types of apparatus available. A section describes the latest development in chemical feeders embodying sveral improvements, including automatic raising of the decanting pipe by the same motor that lowers it, a signal lamp to direct attention to the operating factors of the feeder, remote electrical control to permit most con-

Barber-Greene

THE ONLY VERTICAL BOOM DITCHER



digs clean—leaves no ramp • discharges on either side

Here's an exclusive ditcher feature that saves a lot of hand labor. The Barber-Greene's vertical boom digs *straight down*, right up to walks, foundations, underground piping and mains, etc. *There's no ramp to run up digging costs.*

Closely spaced, self-cleaning "kick out" buckets, traveling at high rate of speed, cut like a milling machine . . . leave a clean-walled trench. It's this efficient operating principle that gets the B-G Ditcher through materials as tough as coral rock — down to 8 feet, 3 inches; widths up to 24 inches. Feeding speeds range from 10 inches to 8 feet per minute.

An adjustable spoils conveyor discharges on either side, and the automatic overload release protects both the machine and hidden objects.

Find out how this compact, maneuverable, easily controlled unit can keep your trenching costs down . . . and what varied work it will perform.

BARBER • GREENE COMPANY, AURORA, ILLINOIS

Constant flow Equipment

LOADERS | PERMANENT CONVEYORS | PORTABLE CONVEYORS | COAL MACHINES | BITUMINOUS PLANTS | FINISHERS | DITCHERS

Designed FOR A SPECIFIC JOB IN WATER WORKS

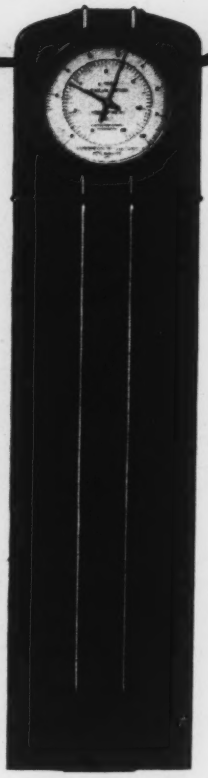
Builders Gauges have been designed and perfected specifically for water works to measure rate of flow, loss of head, sand expansion and liquid level.

Low head — negative head — moist, corrosive atmosphere and other conditions encountered in water works do not prevent Builders gauges from giving dependable performance year after year. The operating mechanism is simple, sturdy and easily maintained. And the smart appearance blends well with modern plant interiors.

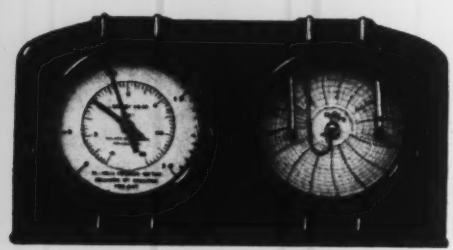
✓CHECK *these Outstanding Features:*

- Easy to read dials and blue-line charts, 10" diameter
- Uniformly-spaced graduations over entire range
- Synchronous electric chart drive. Spring drive optional
- Mechanical, electrical or pneumatic actuation
- Floor stand or table mounting

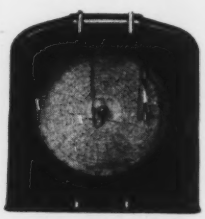
For Bulletin D1-450.20, address Builders-Providence, Inc., (Division of Builders Iron Foundry), 51 Codding St., Providence 1, R. I.



Single dial gauge, mounted on matching floor stand; stand also available for double dial gauges.



Model GA82-IR Gauge indicating and recording loss of head and rate of flow.



Model GA1-R Gauge recording loss of head, rate of flow or water level.

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Venturi, Propelofio and Orifice Meters • Type M and Flo-Watch Instruments
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BUILDERS PROVIDENCE *Instruments*

venient water meter location, micr ne-ter-controlled feeding rate, positive on-slip feeding chain, and the use a synchronous motor for accurately m in-taining the rate of feeding.—*Dept. W, Liquid Conditioning Corp, 114 ast Price Street, Linden, N. J.*

302

Welded Steel Tanks—A beauti lly illustrated booklet describes elev ted steel tanks which are streaml ned welded structures with cylindrical col-umns and ellipsoidal roofs and bot-toms, the columns and struts being fab-ricated from steel plates. They are hermetically sealed to keep out air and moisture, and thus prevent inside cor-rosion. They are used to provide gravity water pressure for general service or fire protection.—*Chicago Bridge & Iron Co., 332 South Michigan Ave., Chicago 4, Ill.*

303

Trailer with Loading Ramp—In this bulletin the manufacturer calls atten-tion to an entirely new principle in a trailer which speeds up the loading or unloading of such types of equipment as tractors, bulldozers, road rollers, trench-ing machines, etc. They are of 7- and 10-ton capacity.—*Arthur Rehberger & Son, Inc., 320 Ferry Street, Newark 5, N. J.*

304

Pumps and Valves—Two Vickers bulletins describe piston-type pumps, hydromotive controls and multiple unit valves. The latter provide finger-touch power hydraulic control for road build-ing, maintenance, excavating, and snow removal equipment, as well as for in-dustrial trucks and dump truck hoists. Other bulletins tell about an hydraulic power steering system, a proportional type oil filter for hydraulic systems, balanced vane-type pumps, and hy-draulic power units.—*Vickers, Inc., di-vision of the Sperry Corp., 1,400 Oak-man Blvd., Detroit 32, Mich.*

305

Wall and Ceiling Panels—Marlite plastic-finished wall and ceiling panels and other products for the building in-dustry are described in a new catalog which gives uses and specifications, as well as illustrated installation instruc-tions. Color chips are used to show the many colors in which Marlite is avail-able. Another interesting feature is complete information and specifications on mouldings, available in aluminum alloy, presdwood and plastic. Detailed information on the new bathroom acces-sories is also included with illustrations of recessed and flush mounting types.—*Marsh Wall Products, Inc., Dover, Ohio.*

Taken for a one-way ride

Tough, sturdy Hewitt Water Suction Hose removes waste water quickly, surely

The hose pictured above is taking an "undesirable" for a one-way ride.

It's being used to pump out seepage water that collected in the excavation. This type of job calls for a dependable, heavy-duty water suction hose. And flexible, rugged Monarch Water Suction Hose is just that kind!

It's built by Hewitt Rubber to "take it" . . . even under constant exposure to wear and abrasion. You can count on it to handle high vacuums without ply separation. You can be sure that water will flow through it quickly and positively with practically no frictional resistance. And you can rely on the tough cover to resist abrasion.

For your difficult drainage operations, insist on Hewitt Monarch Water Suction Hose. You'll find it's the right hose for better, more economical service. For further information call the Hewitt distributor listed in the yellow pages of your phone directory. Or write Hewitt Rubber Division, 240 Kensington Avenue, Buffalo 5, New York.

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Water Suction Hose

4 REASONS WHY HEWITT WATER SUCTION HOSE IS THE BEST

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Spring-steel wire reinforcement in carcass assures protection against collapse under heavy suction.

❷

Thick inner tube especially compounded to resist the scouring action of muddy waters.

❸

Smooth internal fluidway provides swift water-flow.

❹

Tough, abrasion-resistant cover specially constructed to withstand constant exposure to weather.

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City hall clocks always run fast

As every contractor knows, last-minute requests to a surety for bid and performance bond service frequently result in costly delays and embarrassment. When seconds count, city hall clock hands seem to spin! Remember this the next time you have a job coming up and consult with your surety well in advance. Give your surety *time* and your surety can give *you* better service.

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Men and Jobs

R. W. Putnam has been appointed engineer in charge of maintenance of way and structures for the Southern Pacific Railway in six western states, succeeding **Frank L. Guy**, retired. He was graduated in engineering from Colorado College in 1912 an started work for SP the same year as a member of a surveying crew in Oregon. In 1940 he was promoted to division engineer of the Rio Grande division at El Palo, and in 1943 became assistant engineer, maintenance of way and structures, at San Francisco. Guy's retirement ends a railroad career which began in 1900 shortly after he left Kansas University. He was appointed to his engineer post in San Francisco in 1938.

Arnold V. Finch, former Toledo division engineer for the Ohio Highway Department, has been retained by Toledo as a consultant to conduct a survey of street and sewer needs.

Jesse Parker, an engineer in the Albany, N. Y., Bureau of Water since 1931, has been appointed first deputy commissioner in the city's Department of Public Works, succeeding **Alfred D. Schlosser.**

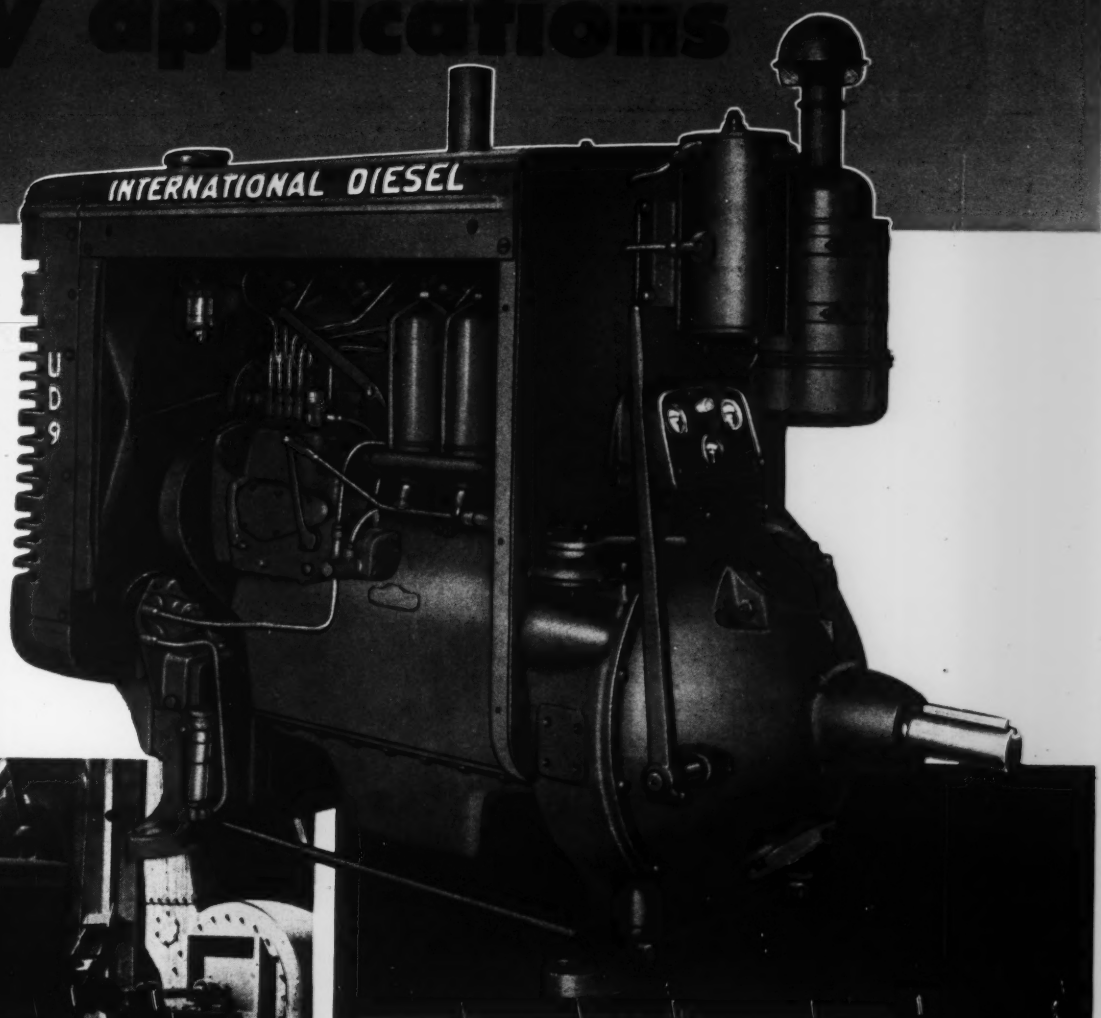
Harry R. Howser has been named engineer of bridges for the District of Columbia, succeeding Clifford R. Whyte who died March 3. After taking civil engineering courses at George Washington University and Catholic University, Mr. Howser was with the federal government for 7 years and joined the bridge department of the district government in 1917. **G. I. Bawer** becomes assistant engineer of bridges.

Royal A. Stone has been appointed chief engineer for the eastern district of The H. K. Ferguson Co, industrial engineers and builders, at New York. Mr. Stone has had long experience in the engineering and construction of plants and processes, particularly with Celanese Corporation of America, General Chemical Co. and Krebs Pigment & Chemical Co. He is a graduate of the Massachusetts Institute of Technology.

Arthur J. McNeill has retired as traffic engineer, Sacramento, Calif. He

...OW-COST POWER

...Duty applications



...dability is built into ...ational Diesel Power ... Construction features ...make them superior ... heavy-duty powering ...clude: self-contained, ...ather starting system; ...ced design combus- ...or maximum utiliza- ...f fuel; single-plunger ...ational fuel injection ...that meters fuel accu- ...to meet all load con- ...s as interpreted by a ...ive, variable-speed ...nor and torque con- ...induction-hardened ...shaft; precision-type ...gs; full-pressure lubri- ...by-pass type thermo- ...ooling, and adequate, ...ent filtering of fuel, ...and air.

Applications of the UD-9 Diesel Power Unit as shown in the pictures to the left are representative of the many and diverse uses to which this dependable power may be put. International Diesels have the lugging ability—the hang on under load—to pull through and deliver the power you require at all times . . . at lowest cost for fuel, lubrication and maintenance.

...ternal power for large-capacity blowers, the UD-9.

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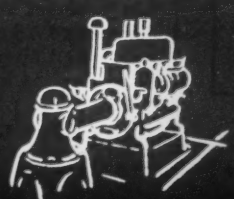

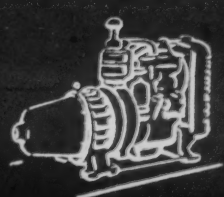

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FOR BRAKE AND CLUTCH USE Velvetouch

Velvetouch clutch discs for steering clutches, front and rear power control unit clutches.

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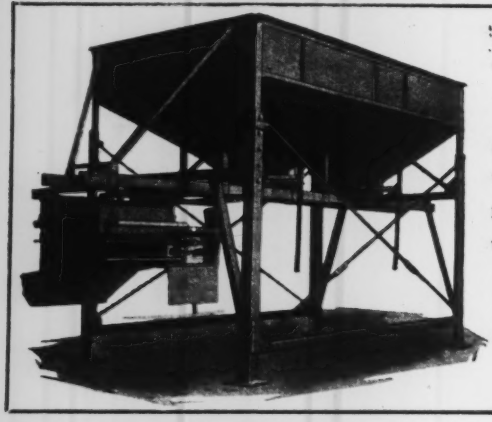

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will continue in the engineering field as a consultant.

Joseph B. Diamond has been appointed deputy commissioner of the New York City Department of Public Works. He is a civil engineer graduate of the Polytechnic Institute of Brooklyn. He has been engaged on many public improvements in New York City and was a civil engineer with Starrett Brothers and Eken. He was a lieutenant commander in the Seabees.

E. W. Ripley, regional construction engineer for the State Road Commission of West Virginia, has resigned to go with the Public Roads Administration district office, Charleston, W. Va. He will be succeeded by **John J. Johnson**, former resident engineer for the commission, who in turn will be succeeded by **Harry Shumate**, a former junior engineer in the commission's District One office.

E. Per Sorensen, of the Knappen Tippetts Abbett Engineering Co., consulting engineers of New York City, has been assigned to Tel Aviv, Palestine, as project engineer on the construction of a $2,000,000 port development.

Roy H. Gagle, materials testing and research engineer for the Montana Highway Department, has been promoted to materials engineer in charge of the testing laboratory at Helena. He succeeds **Scott P. Hart**, who recently became state highway engineer.

Miss Betty Fullerton, Seattle, Wash., architect, who has been assisting in laying out a master plan for an atomic research plant at Richland, Wash., has been employed as an assistant planner by the Toledo-Lucas County, Ohio planning commissions. She is a graduate of Massachusetts Institute of Technology with a master's degree in city planning.

L. B. Bartlett has resigned as public works director at Hamilton, Ohio, to become city manager at Montpelier, Vt.

E. D. Smith, assistant bridge engineer for the Kentucky State Highway Department since 1935, has been promoted to bridge engineer, and **H. R. Creal**, bridge engineer since 1924, to first assistant state highway engineer. Smith is a 1923 civil engineering graduate of the University of Tennessee, and Creal received his civil engineering de-

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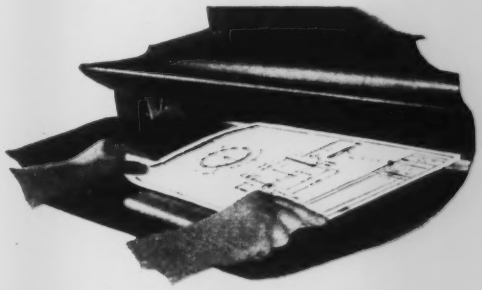

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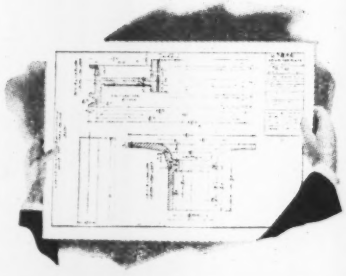

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True case history: Trailer replacement parts are regularly Air Expressed from Kansas City factory. Keeps valuable equipment rolling. Typical shipment: 31-lb. carton picked up 2 P.M. the 11th, delivered Los Angeles, Cal., the 12th, 7 A.M. 1360 miles, Air Express charge only $13.32. Any distance inexpensive, too. Phone your local Air Express Division, Railway Express Agency, for fast shipping action.

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gree from the University of Kentucky.

Other promotions in the department include: **J. F. Stigers,** civil engineering graduate of the University of Kentucky, a director of design succeeding **Dwight H. Bray,** recently named chief engineer. **C. J. Fuller,** principal highway engineer, at Lexington, Ky., moves into the position of chief locating engineer vacated by Stigers. **M. Forrest Johnson** has been advanced to director of maintenance, succeeding **H. H. Palmer,** who will be reassigned to other duties within the department. Johnson holds a B.S. of C.E. degree from Tri-State College, Angola, Ind. **W. D. Barrows,** engineering graduate of the University of Kentucky, has been named acting director of the division of equipment, succeeding **Thomas J. Ready, Jr.,** resigned.

Newly appointed district engineers are: **Edward Is. Lyons,** Elizabethtown; **Rubel L. Parker,** Pikeville; **Henry H. Sandusky,** Somerset; **Lamar Riney,** Madisonville, succeeding **Dewey Sparks** who has been advanced to assistant director of maintenance; **J. A. Reed,** Louisville; and **Lee Puryear,** Paducah.

Thomas Wardrope Eadie, a 1923 graduate in civil engineering from McGill University, has been appointed vice-president in charge of operations of the Bell Telephone Co. of Canada.

Robert S. Newell, assistant to the business manager of the Connecticut highway department, has been made acting manager of the Charter Oak bridge, Hartford. He has been with the department for 21 years.

Henry F. McCrone, Struthers, Ohio, city sanitary officer for 13 years, has resigned.

George Brown has resigned as city engineer at Kelso, Wash.

R. M. Mackinnon, chief engineer and commissioner of works for Halifax, N. S., has been named engineering consultant to the board of works.

Fred Friedewald, Shiloh, Ill., assistant superintendent of highways for St. Clair County, Ill., has resigned in protest against the recent ousting of Superintendent B. C. McCurdy.

Thomas T. Teall, formerly engineer of Worth County, Iowa, has been named county engineer for Davis County. He succeeds **T. F. Matson,** resigned.

John M. Tippee has been appointed city engineer of Des Moines, Iowa for his seventh consecutive 2-year term. **Clarke Beard** has been elected city streets commissioner. **J. R. Balzer** has been appointed consulting engineer for streets.

The view directly above, shows a modern timber-concrete composite deck bridge in Mississippi.

Build with Amcreco Creosoted Products and you incorporate both *beauty* and lasting economy into your project. Records prove that Amcreco treating methods result in products that last longer and require less year-in and year-out maintenance. Let Amcreco engineers work with you on your next job.

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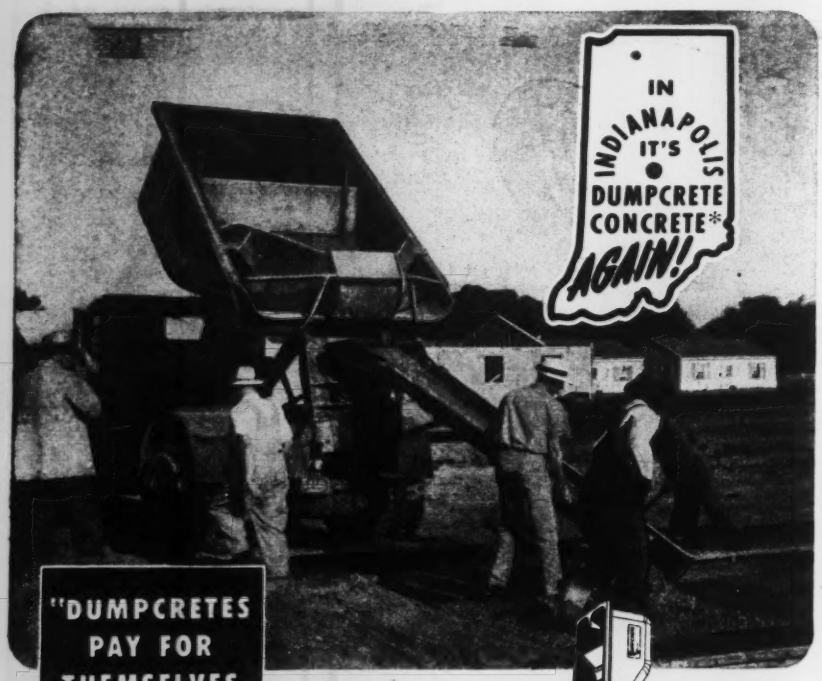

"DUMPCRETES PAY FOR THEMSELVES IN FOUR MONTHS"

The Monroe Corporation, builders of the 10-million-dollar Windsor Village in Indianapolis, bought one Dumpcrete last July and a second in August. These "paid for themselves in 18 weeks." No wonder they bought two more.

They're placing *better* concrete at *lower* cost. Air-entrained concrete is picked up at local ready-mix plant at low price, hauled 3½ miles to job in economical Dumpcrete, chuted quickly into form or onto slab.

Dumpcretes are doing a better job than truck mixers without the expense, and without idle time. Monroe says, "Our concrete bodies are busy every day. When it is cold or wet, they haul sand and gravel."

Concrete men in 41 states are saving just like this with the Dumpcrete. You can too. Write today for 8-page booklet.

DUMPCRETE DIVISION
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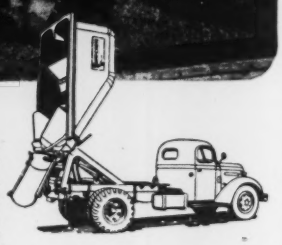
440 Talbott Bldg., Dayton 2, Ohio



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Lightweight, watertight, loads fast, dumps fast or slow, places anywhere, costs less to buy and run. Ideal for hauling aggregate, coal and earth.

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is central-mix air-entrained concrete hauled and placed with the speedy, low-cost Dumpcrete. Provides top-quality, plastic, workable and non-segregating concrete, saving up to $1.00 per yard.

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Elections and Activities

Allied Construction Industries, San Bernardino, Calif., has re-elected C. J. Bakker, of Bakker Construction Co., as president. George Thwing, Jr., was named vice-president, Melvin J. Levin treasurer and Carl L. Hansen secretary.

At the recent annual meeting of the Eastern Snow Conference Pittsfield, Mass., Harvey B. Kinnison, district engineer, U. S. Geological Survey, Boston, was elected president to succeed Edward H. Sargent, chief engineer, Hudson River Regulating District, Albany, N. Y. E. J. Christie, meteorologist, U. S. Weather Bureau, Albany, N. Y., was elected vice-president and Holbert W. Fear, hydraulic engineer, U. S. Geological Survey, Albany, N. Y., secretary-treasurer.

C. Forrest Tefft, Columbus, has been elected president of the Ohio Brick & Tile Institute. Kenneth B. Harris, for the last two years educational engineer of the institute, was named executive secretary of the Ohio region. Other officers include: D. J. Renkert, Canton, vice-president; N. O. Geisinger, New Philadelphia, treasurer; and trustees: O. J. Buehler, Dover, P. W. Hartung, Canton, C. M. Shafer, New Philadelphia, F. H. Johnson, Summitville, K. C. Milliken and Harry Simpson, both of Pittsburgh, Pa., and Paul Schneider, Charleston, W. Va.

The Connecticut Society of Professional Engineers has elected these officers: President, John L. Harkness, Sikorsky Aircraft Division of the United Aircraft Corp., Bridgeport; first vice-president, George L. Mylchreest, Mylchreest, & Reynolds, Hartford; second vice-president, L. Morton Reed, Reed Industrial Eqipment Co., Devon; secretary, Edward J. Nesbitt, Sikorky Aircraft Div., Bridgeport; treasurer, Edwin O. Osteyee, consulting engineer, Bridgeport.

At a recent meeting of the New Brunswick branch of the Military Engineers Association of Canada, Maj. A. E. Hanson, Fredericton, N. B., was named president, and Douglas Johnston, St. John, N. B., secretary-treasurer. W. M. Brannen, St. John, was chosen a member of the dominion council to represent the provincial branch at the annual convention of the association in August, at Ottawa, Ont.

New officers of the Connecticut Society of Civil Engineers, Inc., are: President, William A. D. Wurts, city plan commissioner and manager of the Hartford Metropolitan District; first vice-president, John F. Willis, West Hartford; second vice-president, William M. Bolton, New Haven; district directors: District 1, William M. Creamer, Farmington; district 3, James C. Beach, Hamden; district 4, Valentine O. Ketchum, Stamford.

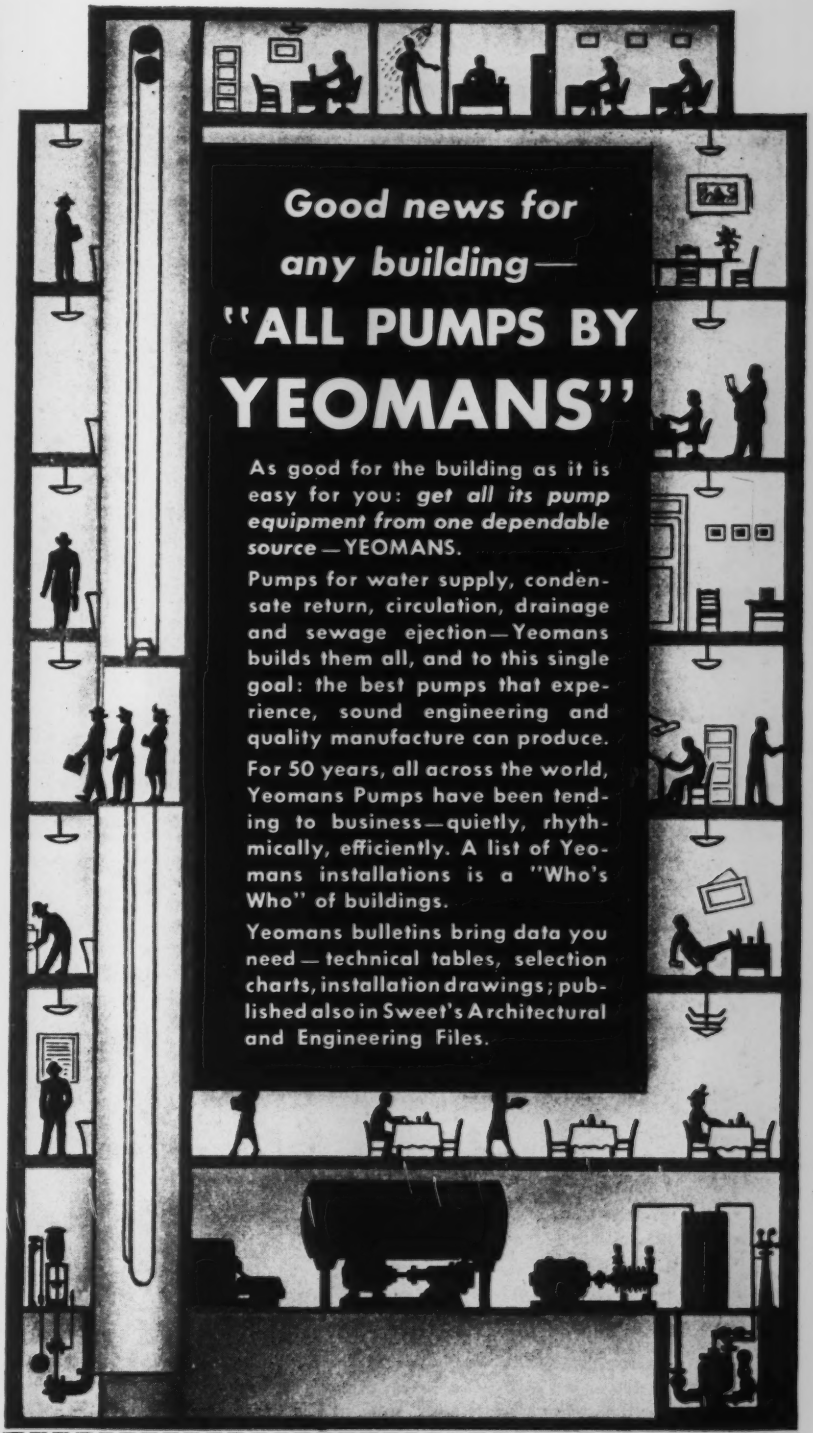
Frederick T. Williams has been elected president of the Niagara Frontier Builders Association at Buffalo, N. Y. He succeeds William H. Merrill. Other officers: Vice-president, Oscar R. Giesecke; secretary, David M. Hannah, and treasurer, Charles F. Peacock. Elected to the board of directors: David M. Hannah, Charles F. Peacock, John G. Percy Jr., Harleigh A. Welsh, C. M. Weinheimer and Edward Setel.

H. M. Bivens of North Wilkesboro, N. C. bridge superintendent with the North Carolina Highway Commission, has been elected president of Unit 8 of the North Carolina State Highway Employees. Other officers for the new lo-county organization are; Munsey Brown of Yadkinville, vice-president and Paul DuPre of North Wilkesboro, highway office engineer, secretary.

At the first annual election of officers of the Nova Scotia Road Builders' Association, held at Halifax, N. S. the following were named; President, D. F. MacIsaac, Halifax; vice-presidents, R. S. Parsons, Windsor and W. P. Bickle, Bridgewater; secretary-treasurer, J. G. Comeau, Halifax; executive, D. R. MacKay, New Glasgow; M. H. McManus, A. E. MacMillan and D. H. Norman, Halifax; D. A. Chisholm, Antigonish; public relations committee D. A. Chisholm, H. H. Latimer and A. E. MacMillan; contracts committee, D. R. MacKay, R. S. Parsons and W. P. Bickle; membership committee, T. Currie, M. H. McManus and D. H. Norman.

A Technical and Engineering Council representing 1,000 members of nine southern New York area technical and engineering societies has been organized, with headquarters in Binghamton. Officers were elected as follows: President, W. W. Perry, chief engineer of the New York State Electric & Gas Corp.; vice-president, Joe E. Gahagan, assistant chief engineer of Ansco. and secretary-treasurer, William H. McFarland, former county engineer. Mine societies are represented on the council.

C. Howard Gordon has been elected president of the Montreal, Que. Builders' Exchange. Other officers: Past-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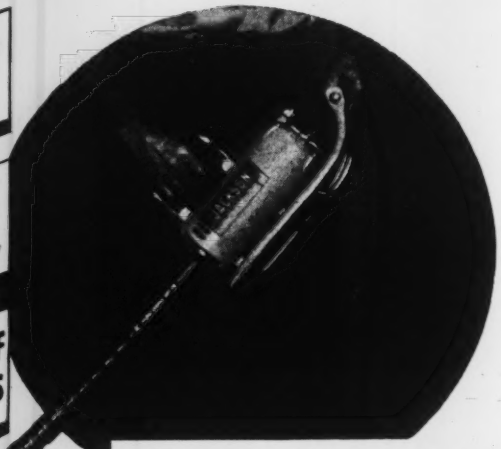

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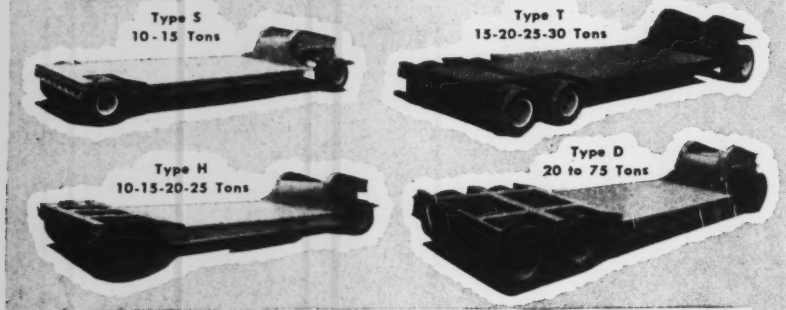
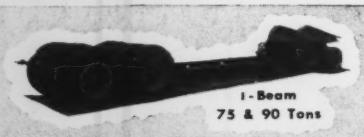


• Choose the one that most nearly meets your needs and ideas. We'll develop a trailer "tailored" to conform to your ideas, adapted particularly to your tractor and efficiently designed to your specific kind of hauling.



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DESIGNERS and BUILDERS of HEAVY DUTY TRAILERS SINCE 1915

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president P. G. Wilmut; vice president and chairman of general contractors section—C. A. Duranceau; vice president and chairman manufactures section—S. M. Barclay; vice president and chairman of Chambre de Construction—J. Rene Hebert, vice president and chairman sub-contractors section C. H. Simpkin; honorary secretary, J. A. E. Montminy; honorary treasurer, R. F. Dykes.

Board of Directors—Roy H. Foss, C. R. Williams, Frank Ross, F. H. Giroux, E. V. Gage, G. A. Goddard, D. Prevost, and E. W. Windram. Secretary-Treasurer is D. A. Paterson and assistant secretary-treasurer is L. J. Plamondon.

George B. Maxey, Kimberly, has been elected chairman of the eastern Nevada Society of Professional Engineers. R. W. Millard, Ely, was chosen secretary and J. F. Sharp, Kimberly, vice-chairman and treasurer. The group will soon become a part of the Nevada State Society of Professional Engineers, affiliated with the national society.

Carl N. Swenson has been elected president of the central California Chapter of Associated General Contractors of America, Inc. He is president of the Carl N. Swenson Co., San Jose. Art B. Smith, vice-president of Engineers, Ltd., was elected chapter vice-president; Harold W. Smith, treasurer, and William E. Hague has been renamed secretary-manager of the chapter.

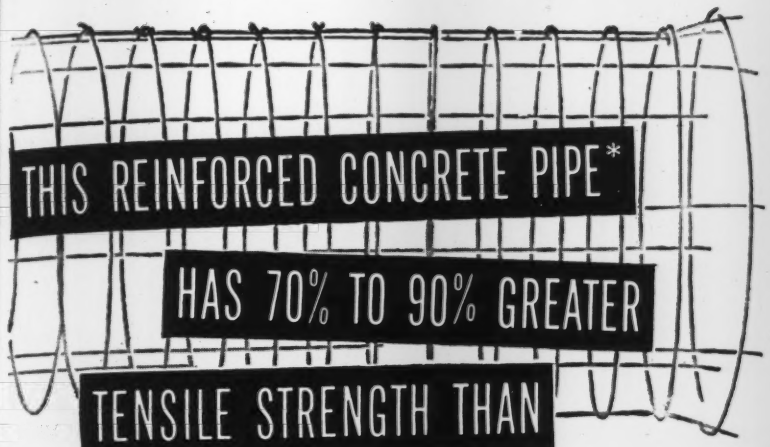
Col. Herbert D. Vogel, U. S. Army district engineer in Buffalo, has been elected president of the Western New York Safety Council.

The Society of Construction Superintendents, New York, has elected these officers: President, August B. Fleck; vice-president, George Martin; secretary, Sidney Millsten; sergeant-at-arms, Joseph Jablon. The society is composed of about 150 men who have supervised construction work.

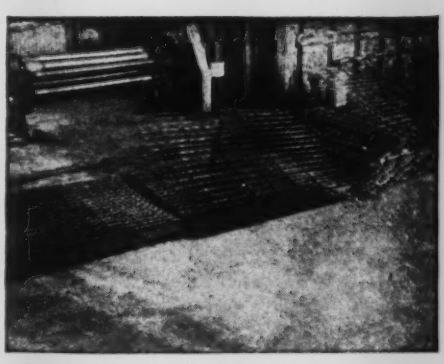
J. D. Burlington, Florence, Lauderdale County, is president of the newly organized association of county engineers of Alabama.

New directors of the Highway 26 Association of Nebraska and Wyoming are: Bert Rymer, Walter Canaday, E. P. Cope, W. F. Schultz, and Walter Shull, Jr.

W. F. Kucharo, president of the Kucharo Construction Co., has been elected president of the Des Moines, Iowa, Master Builders Association for 1948. Fane Vawter is the new vice-president and Ted Lovejoy, secretary-treasurer.



THIS REINFORCED CONCRETE PIPE* HAS 70% TO 90% GREATER TENSILE STRENGTH THAN REQUIRED BY A.S.T.M. STANDARDS



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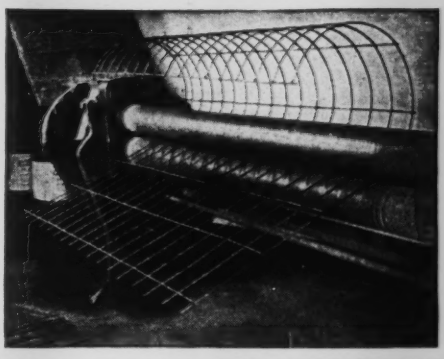

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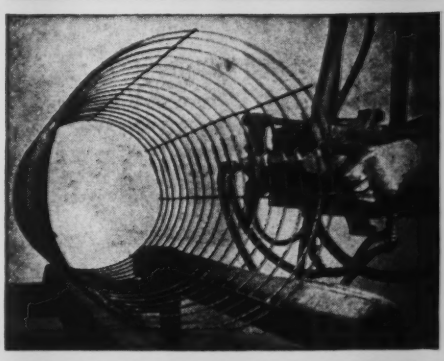

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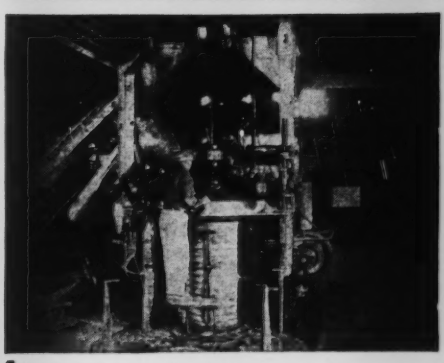

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The high, uniform tensile strength of Clinton Fabric increases resistance to cracking due to load or pressure. It is a product of choice for concrete pipe, sewers and storage tanks. Specify, and be sure you get, Clinton Welded Fabric.

1. Sheets of Clinton Welded Fabric cut to predetermined size preparatory to being formed.

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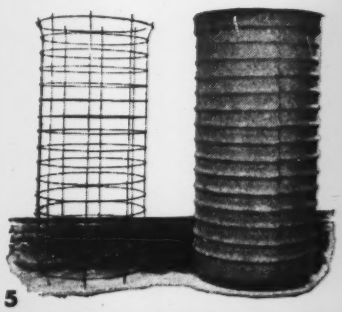
*According to tests made by the Connecticut High Test Sand and Gravel Co., through whose courtesy the information and illustrations were obtained.



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WICKWIRE SPENCER STEEL DIVISION · THE COLORADO FUEL AND IRON CORPORATION · THE CALIFORNIA WIRE CLOTH CORPORATION

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THE Kossier phosphate mines of Egypt were the final destination for three 4-ton Whitcomb Diesel Mechanical locomotives. As these machines were to work underground, definite limitations were imposed—gauge 23⅝ inches, overall width not to exceed 36 inches, height 4 feet 4 inches and length over bumpers 10 feet. As an additional safety precaution, the engine's exhaust was routed through a water muffler, preventing any possibility of flame or sparks entering the mine atmosphere. The 28 HP Diesel engine at 1600 RPM provides a maximum permissible speed of 12.7 MPH and tractive effort of 2660 lbs. in low gear.

These small but powerful locomotives were scheduled to operate continuously 24 hours per day—every day —a gruelling assignment for any piece of moving machinery—anywhere.

Contractors have discovered a source of additional profit by employing Whitcomb locomotives on jobs extensive enough to warrant the use of locomotives. Whitcomb will build locomotives to accurately fit your hauling requirements.

- ***Diesel mechanical locomotives from 3 to 30 tons.***
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THE BALDWIN GROUP

THE WHITCOMB LOCOMOTIVE CO.

PARK & RECORD STS. ROCHELLE, ILL.

Subsidiary of THE BALDWIN LOCOMOTIVE WORKS

Manufacturers' Activities

Current developments among manufacturers relating to expansion of services, shifts in personnel, and other changes, include the following:

Personalities—Chas. F. Kennedy has been elected president of the KENNEDY VALVE MFG. CO., Elmira, N. Y. . . . Thomas T. Parker is pressed metal manufacturing engineer at the Portland, Ore., plant of the HYSTER CO. . . . Charles S. Redding has completed 40 years with LEEDS & NORTHRUP CO. . . . Jens C. Holm has been appointed director of engineering for the MARQUETTE CEMENT MFG. CO., Chicago, Ill. . . . George R. Frankland has been made Chicago district manager of the JOHNS-MANVILLE INDUSTRIAL PRODUCTS DIVISION, succeeding C. H. Hall . . . H. R. Ray is special engineering consultant for ECONOMY PUMPS, INC., Hamilton, Ohio . . . Kenneth V. McCaleb has been appointed superintendent of the Cornelia, Ga., plant of the LUMITE DIVISION, CHICOPEE MFG. CO. . . . W. M. Myers, assistant treasurer of ROCKWELL MFG. CO., Pittsburgh, Pa., has retired after serving the firm for 46 years . . . W. H. Streit has resigned as manager of the TERRE HAUTE, IND., WATER WORKS CORP., and is succeeded by L. G. Hall . . . B. J. Grimm and J. F. Heschong, Jr., have been named eastern division parts manager and assistant, respectively, for CATERPILLAR TRACTOR CO. . . . Frank R. Cooper has been advanced from vice-president to president of the HOWARD-COOPER CORP., heavy equipment distributors, Portland, Ore. W. A. Wyle becomes vice-president and Frank Parker, general sales manager . . . John M. Garoutte has been named manager of the PERMANENTE CEMENT CO.'s plant at Permanente, Calif. . . . J. A. Butler has been named treasurer of the FALK CORP., Milwaukee, Wis. . . . L. L. Smith on April 6 completed 40 years of service with the B. F. GOODRICH CO., AKRON, Ohio.

Distributors—LARKIN MACHINE & EQUIPMENT CO., INC., Rockville Center, N. Y., has been appointed a dealer for DAVEY COMPRESSOR CO., Kent, Ohio . . . FRERICKS and PORTERFIELD, Columbus, Ohio, will act as special agents in central Ohio for the INTERNATIONAL DERRICK & EQUIPMENT CO. . . . BUCHANAN CO., Kansas City, Mo., has been appointed sales agent for LIMA shovels, cranes and draglines in Oklahoma, Kansas and western Missouri . . .Bow

WHAT'S ON YOUR SLATE FOR '48

That sleeping highway construction program has snapped out of its Rip Van Winkle and is going to work with its billion dollar muscles. And airports must be built with good solid concrete runways to handle the gigantic planes of today and tomorrow. Are you ready with Butler Ready Mixed Concrete Plants of greater capacities than ever before? You'll need 'em. Then for another business, remember Central Mixing Plants that are so "push button" your office boy could run them. And on your list - remember Bulk Cement Plants with smart new ideas. And - Batching Plants (Built by BUTLER, of course!) and Weigh Batchers so accurate you can weigh split hairs or an elephant and keep the love of the inspector. AND AS ANOTHER EXAMPLE OF BUTLER ENGINEERING,-THERE ARE CONCRETE PRODUCTS PLANTS There are more on the list- and complete information about them all. Just write for Bulletin 260.

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PEERLESS
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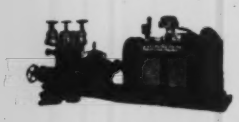
PUMPS

TYPE A
Single Stage Pump

FOR CONTINUOUS DUTY GENERAL SERVICE PUMPING PEERLESS TYPE A PUMPS

Capacities: Up to 70,000 G. P. M.
Heads: Up to 300 feet
1 to 1000 H. P. • All Types Drive



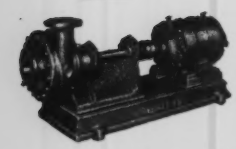
TYPE AF
With Complete Fittings

FOR ADEQUATE FIRE PROTECTION SERVICE TYPE AF FIRE PUMPS*

Underwriters' Approved

Capacities: 500 to 2000 G. P. M.
Pressure: Up to 150 lbs.
20 to 250 H. P.

**Formerly Dayton-Dowd*



TYPE C
Single Stage Pump

FOR ACIDS, CAUSTICS, HOT OILS, CHEMICALS & PROCESS SERVICES... PEERLESS TYPE C PUMPS

Capacities: 10 to 1200 G. P. M.
Heads up to 100 lbs. • 1 to 60 H. P.

FOR MOST SERVICES IN ALL INDUSTRIES

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LAKE EQUIPMENT Co., Seattle, Wash., has been appointed distributor for NOBLE concrete batching equipment in western Washington and British Columbia . . . LEVINSON STEEL SALES Co., Pittsburgh, Pa., is a full-line distributor for the CHASE BRASS and COPPER Co. . . . James T. Henry has been added to the staff of L. S. LUTHER & Co., Washington, D. C., representative of the LIQUID CONDITIONING CORP. of Linden, N. J. . . . A complete new line of Gorman-Rupp centrifugal, self-priming contractors' pumps was recently introduced to Gorman-Rupp distributors from more than 20 states who attended a 2-day preview showing at the GORMAN-RUPP plant in Mansfield, Ohio . . . THE BALL & ROLLER BEARING DIVISION OF LINK-BELT Co. announces the appointment of Arthur E. Maha as assistant sales manager for the central division, with headquarters at the DODGE plant, Indianapolis, Ind.

Sales—John C. Barnes has been elected vice-president for sales of the NATIONAL RADIATOR Co., Johnstown, Pa. . . . J. Bentley Candy has been appointed general sales manager, lubrication division, of the WARREN REFINING and CHEMICAL Co., Cleveland, Ohio . . . Kenneth J. Whisler, Syracuse, N. Y., and W. George Sigler, Pittsburgh, Pa., are new sales representatives of the builders' supply and flooring department of the GOODYEAR TIRE & RUBBER Co.'s chemical products division . . . C. M. Adams is now on the staff of the advertising department of CATERPILLAR TRACTOR Co., Peoria, Ill. . . . Jerome W. Brush, Jr., is assistant director of marketing and merchandising for RAYBESTOS-MANHATTAN, INC., at 120 Broadway, N. Y. City. David E. Cunningham will succeed Mr. Brush as marketing supervisor of the Raybestos division at Bridgeport, Conn. . . . Sidney G. Harris is sales manager of the automotive division of E. F. DREW & Co., INC. . . . Richard M. Stone has been appointed industrial sales manager of the ALLIS-CHALMERS TRACTOR DIVISION, and W. D. Nesbeitt is manager of the Spokane, Wash., district office . . . Frank J. Cain, Jr., has been named sales manager of the CAROLINA GIANT CEMENT Co., Hurleyville, S. C. . . . A. F. G. Raiker has been appointed assistant director of sales in the St. Louis, Mo., general sales office of BEMIS BRO. BAG Co. . . . The former apparatus sales department and the arc welding sales department are merged into one department to be known as the equipment sales department, it is announced by H. F. Henriques, general sales manager of AIR REDUCTION SALES Co., New York City . . . C. C. Wiley, district sales manager for LINK-BELT Co. at Birmingham, Ala., has been appointed to a similar position

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RESTORATION PROBLEMS
Were Quickly and Easily Solved By Our
PRESSURE CONCRETE METHOD!

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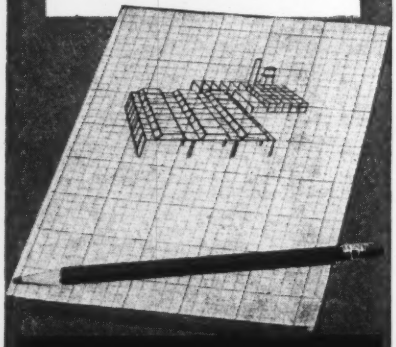
fabricators of
STEEL
for
FACTORY BUILDINGS



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Chicago Decatur, Ill. St. Louis

TOUGH JOBS ARE MADE-TO-ORDER FOR BARCO

★ FREE ENTERPRISE— THE CORNERSTONE OF AMERICAN PROSPERITY ★

Pavement breaking, rock drilling, and clay spading, tamping, driving ground rods or sheathing—the new Barco is a rough, tough, tireless worker. Self-contained, portable, the Barco Portable Gasoline Hammer will do a bang-up job any time of the year at any altitude. Barco's speed and power have been stepped up, *with no weight increase.* Carburetor valve is easier to operate, and a new method of holding the cable makes the hammer easier to handle and prolongs cable life. Eleven special attachments—each instantly interchangeable.

BREAKING · DRILLING · DRIVING · TAMPING

BARCO

PORTABLE GASOLINE HAMMERS

Write to **BARCO MANUFACTURING COMPANY, 1814 WINNEMAC AVENUE, CHICAGO 40, ILLINOIS**
IN CANADA: THE HOLDEN CO., LTD., MONTREAL, CANADA

NOW—Dravo *Counterflo* Heaters can be shipped promptly from stock.

NOW—The unsurpassed leader for open-space heating is available immediately.

AND—Immediate availability means that you can take advantage of the summer air-circulating feature right now. You simply flick the selector switch and the large fans instantly go to work to help maintain comfortable working conditions for employees. Even more important, you'll be prepared in advance for next heating season.

In thousands of industrial and commercial establishments you'll find Dravo *Counterflo* Heaters establishing records for efficiency and economy. They'll prove their worth to you, too, and they can be

SHIPPED IMMEDIATELY FROM STOCK
for Winter Heating and Summer Ventilating.

For quick action call the Dravo Representative listed under "HEATERS" in your classified telephone directory, or contact Heating Section, Dravo Corporation, Pittsburgh 22, Pa.

Dravo also manufactures the **DRAVO CRANE CAB COOLER** *for air conditioning hot-metal crane cabs*

DRAVO CORPORATION

PITTSBURGH · CLEVELAND · PHILADELPHIA · DETROIT
NEW YORK · CHICAGO · ATLANTA · BOSTON

Sales Representatives in Principal Cities

DRAVO

at Baltimore, Md., succeeding H. M. Bowman who has gone to Chicago to be assistant divisional sales manager for power transmission. James T. Bell succeeds Mr. Wiley at Birmingham . . . Roy Schwab will head the new Chicago, Ill., branch of the CHERRY RIVET Co. of Los Angeles, Calif., at 5707 W. Roosevelt Road, Cicero, Ill. . . . Jas. W. Kelley has been added to the Tulsa, Okla., sales engineering staff of VICKERS, INC., of Detroit, Mich., and Fred V. Gieryn at Rochester, N. Y. . . . More than 40 salesmen from all over the U. S. attended the recent annual sales meeting of the MORSE CHAIN CO., Detroit.

Deceased—W. J. Van Valkenburgh, 57, president of the BLUE DIAMOND CO., building materials suppliers, died in Los Angeles, Calif., March 24; Alexander L. Bletz, 53, plant engineer for SKF INDUSTRIES, INC., Philadelphia, Pa., died April 1; Leon H. Marsh, vice-president and secretary of the KENNEDY VALVE MFG. CO., Elmira, N. Y., died March 11; H. E. Chambers, Jr., manager of the Dallas, Tex., office of A. H. LOCKETT & CO., LTD., died March 11.

Miscellany—LIQUID CONDITIONING CORP. is completing an addition to its plant at Linden, N. J. . . . An elastic, acid resistant and water repellent coating for insulation has been developed by REARDON INDUSTRIES, Cincinnati, Ohio . . . R. G. LETOURNEAU, INC., has expanded its marketing program and has issued a clarification of its corporation marketing policy as it applies to recent product diversification. LETOURNEAU is now organizing a new group of specialized distributors to handle new products, which include house building, material handling, and heavy construction equipment. The company has a new full color sound movie entitled "Material on the Move," available from the Peoria, Ill., office or through CATERPILLAR distributors . . . Construction of UNITED STATES PLYWOOD CORPORATION's 28th branch warehouse will be started soon at 3333 N. W. Front Avenue, Portland, Ore. . . . A new sound motion picture on the P & H SINGLE PASS SOIL STABILIZER has just been completed by HARNISCHFEGER CORP., Milwaukee, Wis. . . . GAR WOOD INDUSTRIES, INC., has signed a 20-year lease for 6½ acres of land and a 122,000-sq.ft. building in Richmond, Calif., to be the West Coast center for assembly and distribution. . . . EASTERN TRACTOR, Kingston, N. Y., has bought the EDDY PLOW WORKS of Greenwich, N. Y., established in 1832 . . . New design and developments for kitchens, bathrooms and other consumer plumbing installations will be accented by THE SCHAIBLE CO., Cincinnati, Ohio, in educational exhibits at plumbing industry meetings throughout the United States.